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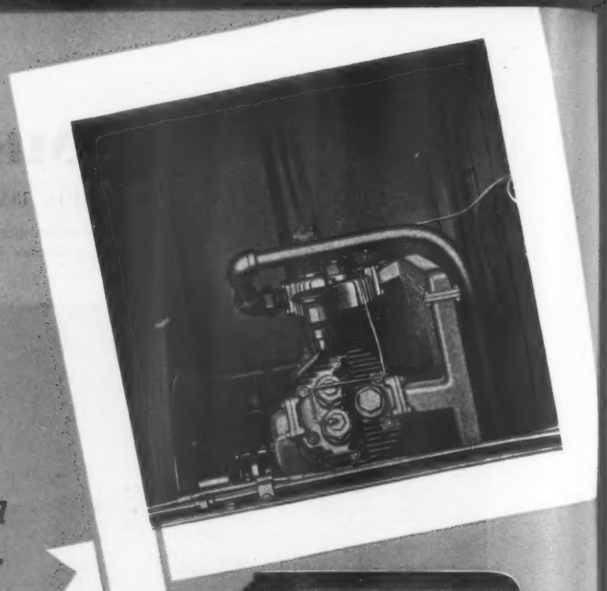

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Truck-Spring Snubbers*

By W. S. Spieth†

The development of the truck-spring snubber—Test data included to show characteristics of coil springs and snubbers acting independently and in combination

THE truck-spring snubber as applied to railroad freight cars is a comparatively new device. Ten years ago there were very few of them in service. Today, many thousands of freight cars are equipped with them and every day they are being applied to more and more new and existing cars. They are used to make cars ride evenly and smoothly, and by doing this they protect the lading and decrease the cost of maintenance of the rolling stock as well as the roadbed.

The freight-car snubber is often referred to as a spring. It fits into and acts as part of a spring group. It possesses some of the functions of coil springs, particularly the ability to cushion or absorb shocks. However, it does not have some of the other characteristics of coil springs, which I will explain later, and the use of coils cannot be wholly eliminated by the substitution of snubbers. This is a fundamental consideration and, because it is sometimes overlooked, I want to emphasize that it is necessary that coil springs be used in combination with snubbers. Also, it is now generally recognized that it is necessary for snubbers to be used in combination with coils in order to effect the most efficient and most economic freight-car operation.

In discussing truck-spring snubbers, therefore, we must consider them in combination with freight-car coil springs and, as the history of coil-spring design and performance is so closely interwoven with snubber development and usage, it is advisable to review this history rapidly as a background for our discussion of truck-spring snubbers.

As was the case with most other freight-car devices "away back when," there were several different designs of coil springs used under cars built by the different railroads and most of them gave a fairly good account of themselves in service. In those days car capacities were not as great as they are today, freight-train speeds were slower, and average yearly freight-car mileages were lower. There was less damage to ladings enroute and the cost of freight-car maintenance had not assumed the proportions it has today. The coil spring was giving satisfactory results in service and it continued to do so for a number of years after the turn of the century. Probably the best evidence in support of this statement is the fact that the spring design that we know today as the A. A. R. 1915 coil was adopted as a standard in 1915 after having been adopted as a recommended practice in 1901.

During this period there was a gradual increase in the size and carrying capacity of freight cars. The car with 100,000 lb. capacity came into general use and a considerable number of cars with 140,000 lb. capacity were built. Some of the coal roads also began to use 90- and 100-ton cars for special services. In the post-war period certain other changes were made in car carrying capacities and operating methods that had a marked effect on spring performance. In 1920 the A. A. R. increased the permissible carrying capacity of the 5½-in. by 10-in. axle from 38,000 lb. to 40,000 lb. and at about the same time changed the interchange car loading rating from a nominal capacity rating plus 10 per cent to an axle-capacity rating. This resulted in a material increase in the maximum loads that cars were permitted to carry.

In this post-war period the railroads, in the interest of better service and more efficient utilization of equipment, began to increase freight-train speeds and average freight-car mileages. These efforts have continued to gather impetus ever since they were inaugurated, and today some freight-car services are contemplated that will require sustained freight-train speeds of 85 and 90 m. p. h.

As car loads, freight-train speeds, and freight-car average mileages were increased, the railroads began to experience a considerable amount of spring breakage which, as time went on, developed into a serious prob-

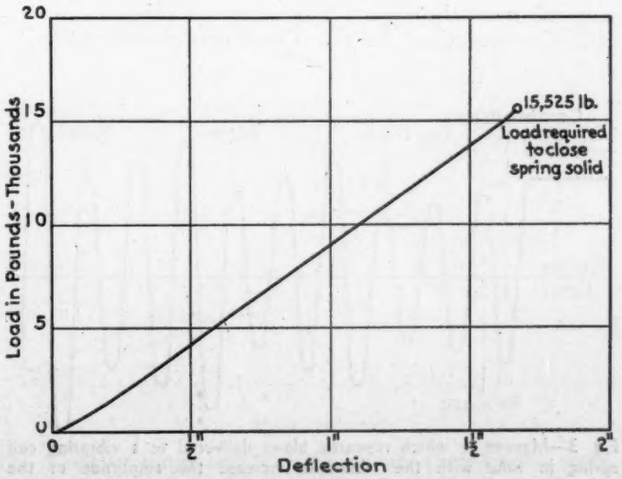


Fig. 1—Calibration curve of a standard A. A. R. 1936 outer coil spring

* Paper presented at the meeting of the Northwest Carmen's Association on March 4, 1940.

† Manager, Simplex snubber department, American Steel Foundries. Mr. Spieth was assisted in the preparation of this paper by J. E. Tarleton, Cardwell-Westinghouse Co.; Cyrus Holland, Holland Company; H. T. Casey, Symington-Gould Corporation, and G. H. Snyder, American Steel Foundries.

lem. Apparently the trouble was not with the design of the coils, as such, because the spring that was now failing had been in use for a number of years and had not developed a design weakness. The logical reason for the failures seemed to be that the spring groups were

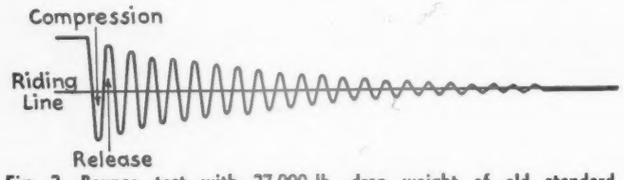


Fig. 2—Bounce test with 27,000-lb. drop weight of old standard A. A. R. coil springs, Class C

being required to carry heavier loads at higher speeds with the result that under these conditions springs were going solid to an appreciable extent. Marks or indentations between the coils of failed springs was evidence that this was a major contributing factor in spring breakage.

The solution of the problem seemed to be increased spring-group capacity and a number of tests were made on cars in service to determine how much increased capacity was required. These tests developed that under the conditions that prevailed at that time the live loads on freight-car spring groups amounted to approximately 2.1 times the corresponding dead or static loads and that spring groups with capacities in excess of this ratio were necessary if springs were to be kept from going solid. This, naturally, led to changes in truck design which provided an increased amount of space in the bolster opening of the side frame to permit the use of an increased number of coil springs and thus an increase in spring group capacity without necessitating a change in coil-spring design. The Dalman and the double-truss designs were developed for this purpose and were generally used.

Shortly after spring breakage reached serious proportions, the question of shippers' claims for materials damaged enroute also became a more serious problem. The packers were among the first to notice this when they began to experience increased losses caused by fresh meat being torn from hooks in cars during shipment. Increases in claims in connection with all fragile materials were experienced and even claims for damage to such items as tile and sewer pipe reached sizeable amounts on some railroads. This increased the scope of the spring investigations when it was developed that the action of the spring groups was having a considerable effect on the size of these damage claims.

In the meantime the Car Construction Committee of

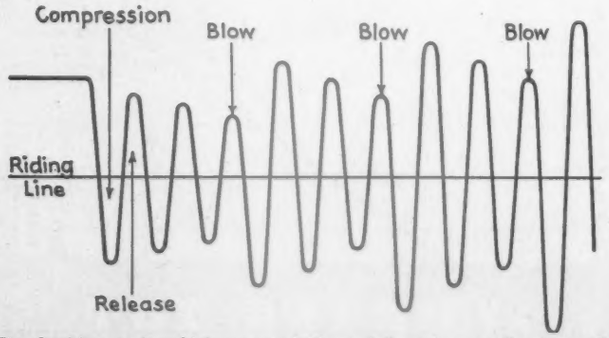


Fig. 3—Manner in which repeated blows delivered to a vibrating coil spring in time with the vibrations increase the amplitude of the oscillations

the American Railroad Association was actively studying the question of freight-car spring design. They made certain changes in the tentative standards in 1921 shortly after acceptable axle-carrying capacities had been increased. In 1932 they recommended a change in coil-spring design which materially increased the carrying capacity of the outer and inner coils. Their recommendation was adopted as a tentative standard in the same year. Subsequently, the Committee revised this design to one having less capacity per coil than the 1932 standard but more capacity than the 1915 standard. This revised design was recommended by the Committee to the Association in 1936 and that year was adopted by the Association as the recommended standard. It is known as the A. A. R. 1936 standard coil spring. One A. A. R. 1936 double coil has approximately 16 per cent more carrying capacity than an A. A. R. 1915 double-coil spring. The increase in capacity is obtained by an increase in the diameter of the bars from which the springs are coiled.

Increased spring capacity, obtained either by the use of more coils or by the use of the 1936 coils, has reduced the tendency of the springs to go solid. However, it has also increased the stiffness of the spring groups, with the result that, at the normal speeds at which freight trains are operated today, lightly loaded

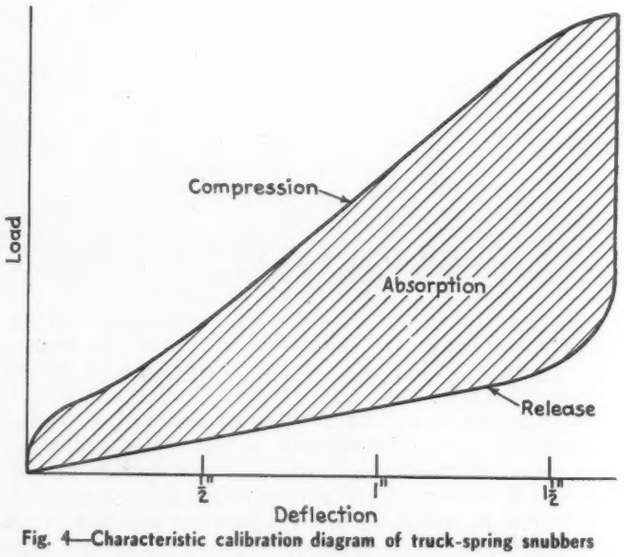


Fig. 4—Characteristic calibration diagram of truck-spring snubbers

or empty-car bodies bounce or jiggle around on top of these stiff springs like cigar boxes. Stiff spring groups approach the effect of a solid block when the load on them is not great enough to produce a sufficient spring action.

A fully loaded 50-ton freight car is designed to carry a dead load of about 39,250 lb. on each spring group. When the car is empty the load on each group is approximately 8,000 lb. This is a difference of nearly 500 per cent. It makes the problem of using an all-coil spring group a most difficult one, as it is practically impossible to build up an all-coil group that will prevent the frequent recurrence of solid blows when the car is loaded and at the same time be soft enough to keep from damaging light, fragile loads and loosening up the car body when it is empty.

The first efforts in the direction of increased spring capacities were founded on the assumption that spring groups had to be designed to take blows of certain magnitudes. However, as investigations proceeded, greater attention was directed to the fact that it was only when

trains were being operated at certain speeds that increased capacity was necessary and that at lesser or greater speeds the same car rode smoother and the spring groups did not go solid. This suggested an analysis of the action of the spring groups at these particular speeds to determine if something could be done to reduce the magnitude of the blows and this analysis was the beginning of the development which has led up to the use of the freight-car truck-spring snubber.

Before we go any further, it is interesting to note that the fundamental difficulties that initiated these investigations were excessive spring breakage and high maintenance cost and not damage claims, as some of us might think. Unquestionably, damage claims were a contributing factor but maintenance costs were the original incentive and we believe they are today the biggest reason why truck-spring snubbers should be used under all kinds of freight cars.

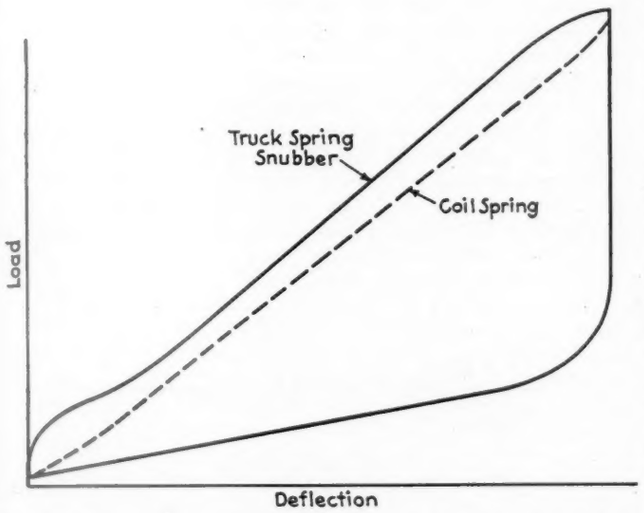


Fig. 5—Comparison of calibration diagrams of a coil spring and a truck-spring snubber

Characteristics of Coil Springs and Truck-Spring Snubber

The coil spring, when it is compressed, stores up energy. It does not dissipate it. When it is released it gives back practically all of the energy, or force, that was required to compress it. Fig. 1 shows a calibration curve of a standard A. A. R. 1936 spring. As this spring is compressed the force required to compress it through each ½ in. of its travel between its free and its solid height is the same. In other words, it does not take any more force to close it the last ½ in. than was required for the first ½ in. That is the reason that its compression characteristics are represented by this straight line. As the spring is released, it gives back the same pressure in each ½ in. of its travel that was required to compress it that amount, which means that its release characteristics are represented by this same straight line. This is the basic feature of coil-spring action.

When you drop a weight on a coil spring it vibrates up and down just like a punching bag vibrates back and forth when you hit it. In 1933 the Mechanical Division of the A. A. R. conducted a series of tests of trucks and truck springs designed to permit easier riding and reduce harmonic action. Fig. 2 is a reproduction of a curve that was developed in these tests. It shows how coil springs deflect and continue to vibrate when a weight is dropped upon them. You will notice how the spring group bounces up and down until the vibrations finally die out just like a punching bag. These regularly continued vibrations are called harmonic action.

Fig. 3 shows a curve that we have constructed to illustrate a point. In making it, we have assumed that, first, a weight is dropped on a coil spring to start it vibrating. Then, at every fourth vibration an additional blow is delivered to the spring in time with the vibrations and in the same direction. It is obvious what happens. The additional blow simply adds to the length of the natural vibration set up when the weight was dropped on the spring and when the amplitude of every fourth vibration is increased in this way there is a build-up that increases the magnitude of the vibrations out of all proportion to what would be produced by any one of the blows. What actually happens to a coil spring when it is given successive blows like this in time with its natural vibration is that it goes solid and, of course, it only goes solid so many times before it breaks.

Similarly, when a group of springs carrying a certain load under a freight car is subjected to a blow, the springs begin to vibrate up and down. Then, if another blow is delivered to the spring group at just the right time it builds up the vibrations and it doesn't take many more blows delivered at just the right time to build them up to the extent that the springs go solid. This does happen to freight cars and the speeds at which it happens are called "critical speeds." The regular blows that are delivered to the spring group are due to the rail joints which the trucks pass over. Of course, the rail joints are evenly spaced and this action takes place when the blows from the rail joints are in time with the natural vibration of the springs. Out-of-round wheels and other track irregularities will produce the same rhythmic effect and when two or more of these conditions act in harmony with each other the combined effect is more severe.

A car carrying a given load has several different critical speeds. In this diagram we have assumed that additional blows are delivered to the spring every fourth vibration. We might have assumed that the blows were delivered every third or fifth vibration. Had we done this, we would have increased or decreased the rapidity with which the blows are delivered and, of course, increased or decreased the rate at which the amplitude of the vibrations build up. Different freight-train speeds produce this difference in the time rate of delivery of

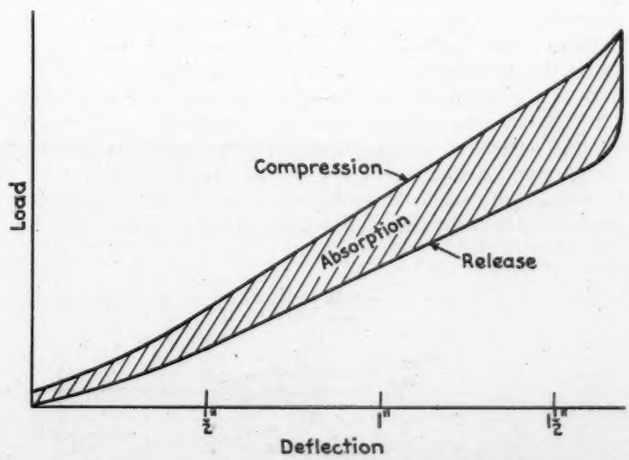


Fig. 6—Characteristic calibration diagram of a combination group consisting of a truck-spring snubber and coil springs

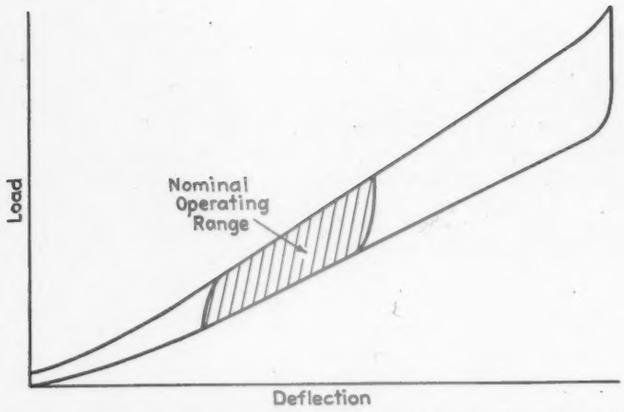


Fig. 7—Nominal operating range of a combination coil spring and truck-spring snubber group under a partially loaded car

blows and build up, which you can readily see is responsible for different critical speeds.

When a car is operated at a critical speed, and particularly at the higher critical speeds, it bounces up and down or oscillates most violently. Sometimes the action is severe enough actually to lift the bolster off of the spring seats. There is not a fine hairline difference between critical and non-critical speeds. Each critical speed is the center of what is termed a "critical speed range" which includes speeds that will vary from three to five miles per hour on each side of the exact critical speed. Usually springs go solid and cars always ride very roughly whenever the speed is within any critical range.

Truck-spring snubbers possess some characteristics that are vastly different from those of coil springs. When a truck-spring snubber is compressed, it not only absorbs energy, but it dissipates it. It differs from a coil spring inasmuch as it does not store up all of the energy that is delivered to it. Therefore, when a truck-spring snubber is released it does not give back the same amount of energy or force that was required to compress it.

Fig. 4 shows a characteristic calibration curve of a truck-spring snubber. Now this paper was prepared by a number of manufacturers of truck-spring snubbers. This curve does not illustrate the details of the action of any particular snubber but does show the general characteristics that are common to all of these truck-spring snubbers. The top line is the compression line. It indicates the amount of force that is required to compress the snubber through any given portion of its travel. The lower line is the release line. It indicates the pressure that the snubber gives back when it is released. The shaded area between the two lines represents the amount of work that is put into the snubber and not given back or, in other words, this represents the amount of energy that is dissipated. All truck-spring snubbers employ friction generated in one way or another as the means for dissipating energy.

Fig. 5 compares the calibration curves of a coil spring with the characteristic calibration curve of a truck-spring snubber. It illustrates the difference in the compression and release characteristics of these two devices. The broken line shows the coil spring characteristics. It gives back the same force at the same rate that it stored it up. The solid line represents the action of a truck-spring snubber. Its compression and release characteristics are different. It would not function as a snubber if they were not. The real reason for designing a snubber that will give back any force at all when it is released is to insure a positive release and make sure that the follower wedges will always remain against the spring seats on the up stroke of the spring group.

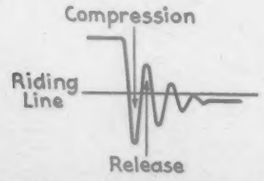


Fig. 8—Bounce test with 27,000-lb. drop weight of old standard A. R. A. coil springs and truck-spring snubbers

Fig. 6 is a characteristic calibration diagram of a spring group consisting of coil springs and a truck-spring snubber. This shows the effect on the group of the dissipation of energy by the snubber. As in Fig. 5, the upper line is the compression line, the lower line is the release line, and the shaded area between the two represents the absorption of the group. This is a calibration which covers the total deflection of the group. It charts the deflection characteristics throughout the entire travel between free and solid heights.

Fig. 7 shows the compression and release characteristics of the same group through a nominal working range. Combination snubber and coil-spring groups are never deflected through their entire range while in actual service. When carrying normal loads at normal speeds, the actual deflection range of the groups rarely exceeds ½ in. The shaded area and its boundaries indicate the compression, release, and absorption characteristics of the group acting through a nominal deflection range.

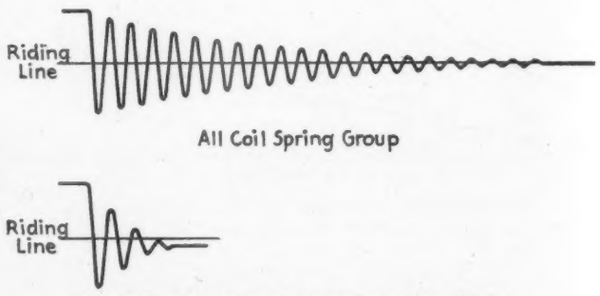


Fig. 9—Comparison of the bounce tests of all-coil spring group and the group consisting of a truck-spring snubber and coil springs

Fig. 8 is a bounce test diagram of a combination coil-spring and truck-spring snubber group. This is also a copy of one of the tests made by the Mechanical Division of the A. A. R. in 1933 in connection with the tests on trucks and truck springs designed to promote easier riding. It shows how a truck-spring snubber dampens out coil spring vibration or harmonic action. In doing this it prevents the build-up of violent spring action from one rail joint to the next and, because it prevents this violent action, it reduces the coil spring capacity required to prevent the spring group from going solid. This is an important fact and must be taken into consideration if the best light car riding characteristics are to be developed.

For all-coil spring groups the A. A. R. recommends a minimum coil capacity of approximately twice the maximum static load that will be carried by the spring group. Where truck-spring snubbers are used in combination with coils, the coil capacity can safely be reduced to less than one and one-half times the maximum static load that the spring group will carry. This, of

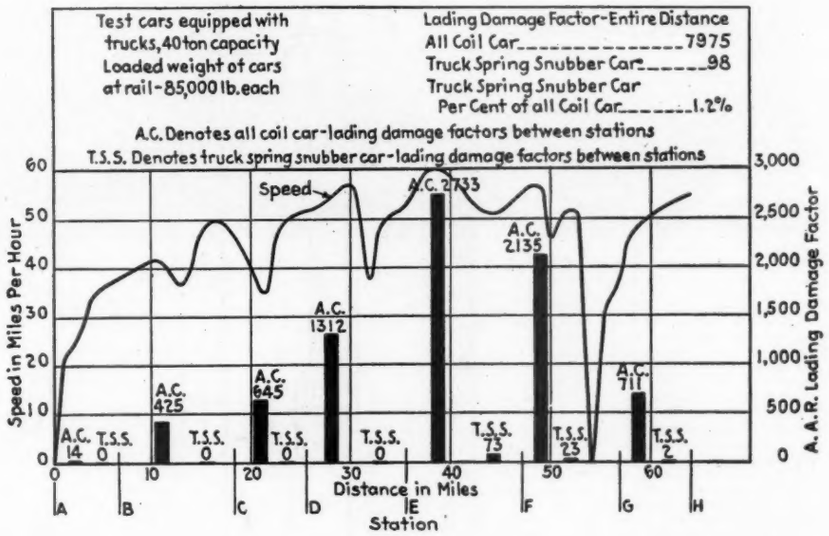


Fig. 10—Comparison of riding characteristics of all-coil spring groups and combination truck-spring snubber and coil-spring groups

course, makes a softer spring group and one that is much better suited for the operation of an empty or lightly loaded car.

Fig. 9 compares the bounce test of coil springs with the bounce test of a combination coil spring and truck-spring snubber group. It shows how a truck-spring snubber breaks up the harmonic action of coil springs and in so doing prevents the build-up that makes springs go solid. By damping out so many coil-spring vibrations, it greatly reduces the wear on the columns of the side frame. This goes as far as laboratory demonstrations can to show the value of truck-spring snubbers.

Fig. 10 shows a much more practical example of their value. It shows the results of a comparative road test of a car equipped with all-coil spring groups and another car equipped with a snubber-coil spring combination. The test was conducted over 62 miles of main-line track passing stations *A, B, C; D, E, F, G,* and *H,* as shown. The top line indicates the speeds at which the test train was operated. The columns marked *AC* and *TSS* indicate the lading-damage factors that were developed in the respective test cars between each of the stations. *AC* denotes the all-coil spring group car and *TSS* the truck-spring snubber equipped car. You will note that between stations *E* and *F* the all-coil car developed a lading-damage factor of 2,733, while the truck-spring-snubber car only developed a lading damage factor of 73. A lading-damage factor represents the number of blows and the intensity of the blows that are delivered to a car body as measured by instruments that are specially designed for this purpose. The instruments used in this test are exactly the same as those that have been used by the Association of American Railroads in their riding-quality tests and the lading-damage factors were determined by the use of the same formula that the Association of American Railroads uses. It is interesting to note that the lading-damage factor developed by the truck-spring snubber equipped car over the entire distance was only 1.2 per cent of the lading-damage factor developed in the car with all coil-spring groups.

Fig. 11 shows a comparison of the riding characteristics of 50-ton coal cars equipped with all-coil groups and combination truck-spring snubber and coil-spring groups. These results were obtained on another railroad by the use of an instrument that graphically records the oscillations of the carbody which can be interpreted in terms of the magnitude of the blows delivered through the spring groups. You will note that the forces delivered to the spring group of the snubber-equipped car were never sufficient to close this group. In fact, due to the dampening action of the snubber, there always remains an additional reserve capacity of at least 19,000 lb. over the most severe blow that the group had to absorb.

(*Continued on page 189*)

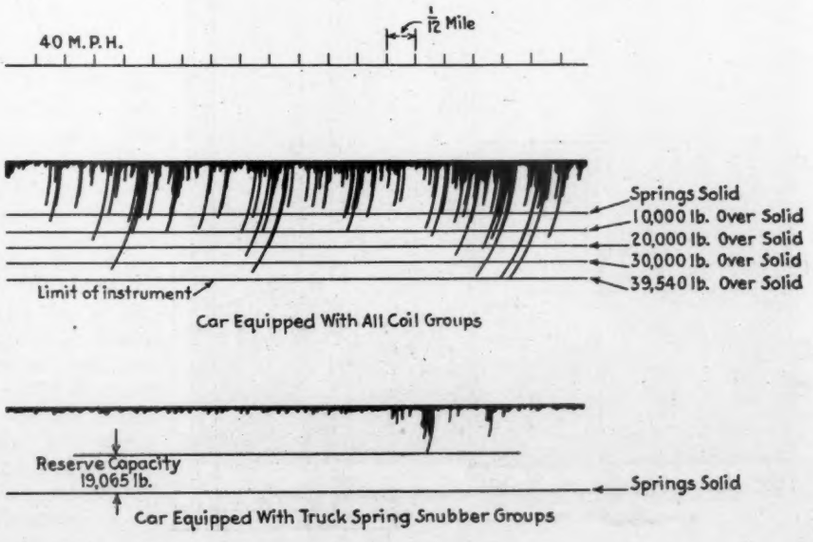
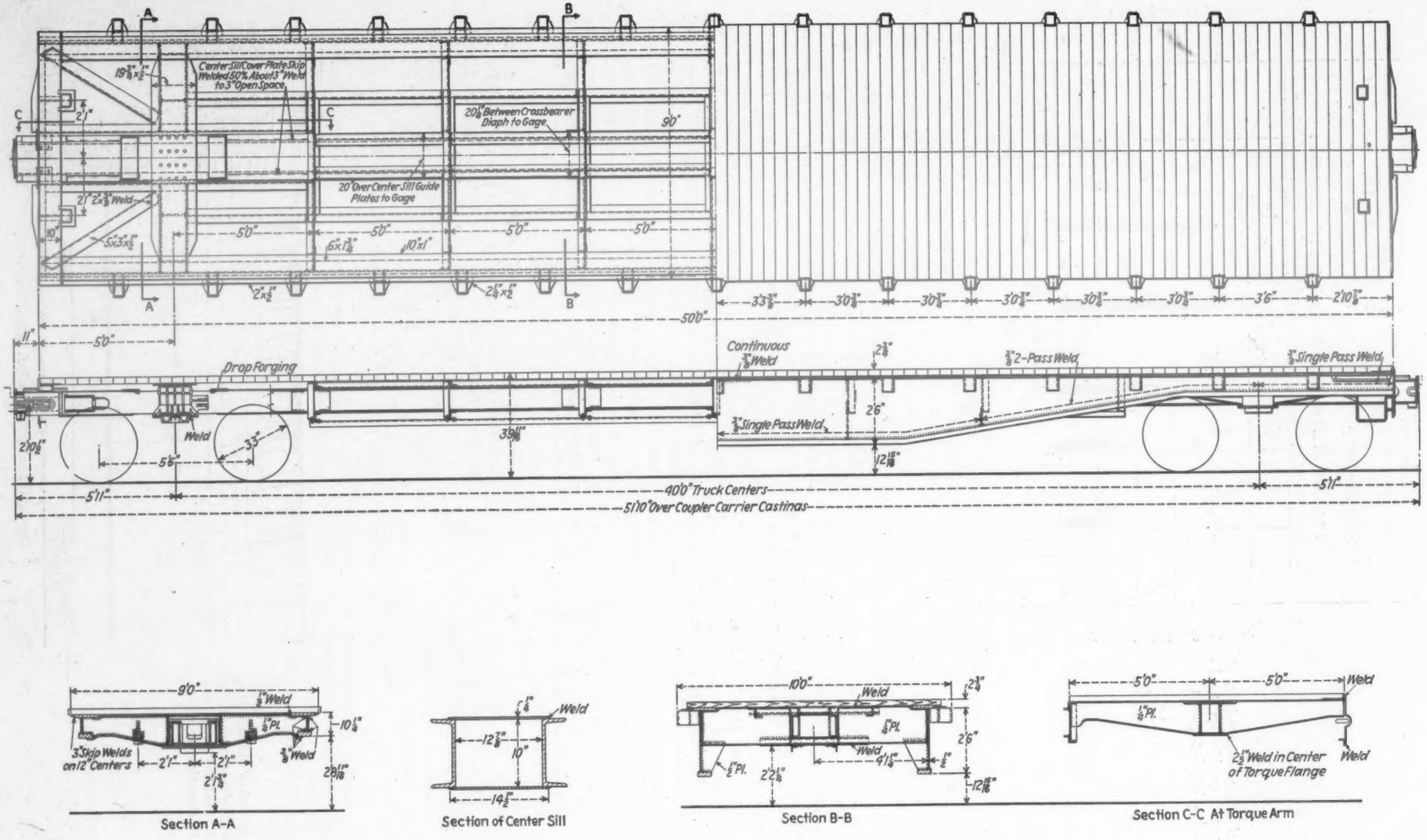
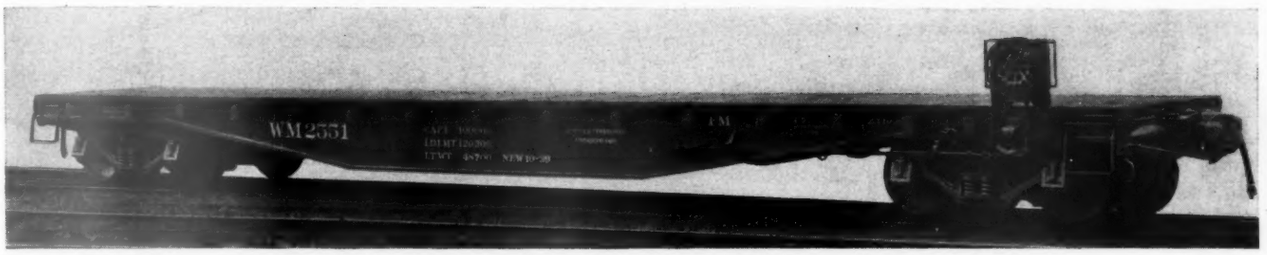


Fig. 11—Comparison of the riding characteristics of 50-ton coal cars; one equipped with all-coil spring groups and one equipped with coil-spring and truck-spring snubber groups



Sectional plan, elevation and cross-sections showing welding details of Western Maryland all-welded flat cars



Western Maryland

All-Welded Flat Cars

These cars for general flat-car service are equipped with the Duryea cushion underframe and have an unusual hand-brake arrangement to facilitate the loading of the cars

THE Western Maryland has recently placed in service ten 50-ton flat cars of all-welded construction built by the Greenville Steel Car Company. The cars have a length of 51 ft. 10 in. over the coupler carrier castings and a light weight of 48,700 lb. They are equipped with the Duryea cushion undeframes which, besides affording more than normal protection to the car body and lading, permits them to be utilized in twin-load service without blocking out the draft gears between the cars. The Ajax hand brakes are applied to a hinged support on the sides of the cars and can be dropped to a position in which they will not interfere with the loading of the cars over the sides.

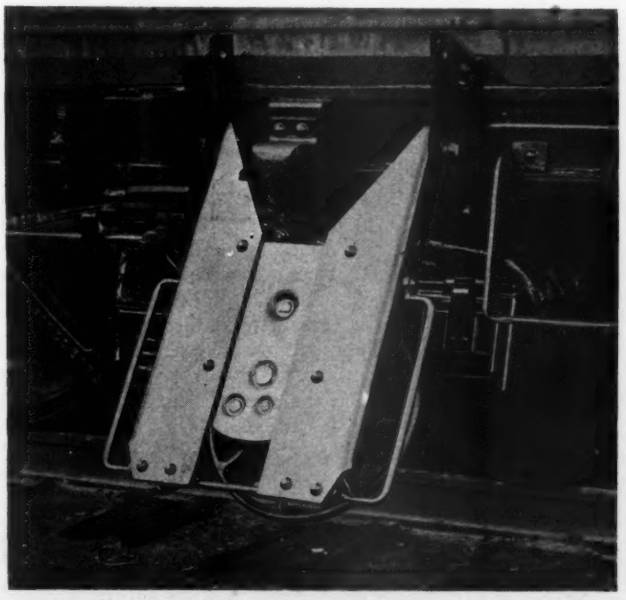
The center sills are of box girder design consisting of two 10-in. channels with ¼-in. top and bottom cover plates, skip welded to the channels, which extend to within a distance of 7-in. from stop faces on the bolsters. Drop forgings have been welded to the bolster end of the top cover plates to serve as stops to limit the movement of the cars with respect to the center sills. Vertical plates, ⅜ in. by 9 in. by 4 ft., are welded to the outsides of the channels where they pass through the bolsters.

The side sills are designed to carry the entire load. They are built up with horizontal top and bottom members to which a vertical web plate has been welded. The top member is of 1-in. by 10-in. plate and is welded to the web plate by ⅜-in. continuous welds on both sides. The bottom member is of 1¾-in. by 6-in. plate and is welded to the web plate by both ⅜-in. single-pass welds and ⅜-in. two-pass welds as indicated on the drawing.

The bolster construction is essentially of A. A. R. design except that it is welded throughout and has a cast-steel center brace to carry the movable center sill. The horizontal top member of the bolster is of ½-in. by 19¾-in. plate, the bottom member is of $1\frac{1}{16}$-in. by 14-in. plate, while the vertical members are of ¼-in. plate.

There are seven cross-bearers, each consisting of a pressed diaphragm with 3-in. Z-bar members at the top and bottom welded into a single unit and to the side sills. They are formed with an opening of 20¼ in. at the center to permit the movement of the center sill. Along the top and bottom of the diaphragms are welded 3-in. Z-bars. The cross-bearers have supports of ½-in. plate welded to the bottom horizontal member, to the inside of the side sills, and to the diaphragms. The cross-bearers are all tied together with continuous longitudinal angles, one under each center-still channel, which are riveted to the bottom flanges of the diaphragms.

Diagonal braces of 5-in. by 3-in. by ½-in. plate to the corners of the car are welded to the top horizontal member of the bolster and to the end and side sills. Four lines of Z-bar floor supports are welded between the bolsters and the diaphragms and extend from bolster to bolster. The cars have 2¾-in. oak flooring for greater strength and to furnish a surface suitable for the application of blocking. The welding throughout the car is of ¼-in. welds unless otherwise noted on the drawing.



The Ajax hand brake may be swung to a position that will not interfere with loading over the side

The Causes and the Prevention of

Embrittlement in Boilers*

By W. C. Schroeder†

Investigation shows a combination of four conditions must exist simultaneously to produce embrittlement—Chemical treatment—The use of the embrittlement detector

EMBRITTLEMENT cracking in the riveted seams of locomotive boilers has been encountered and definitely identified on a considerable number of American railroads. It is probable that in some slight degree, and perhaps without identification as embrittlement, the trouble has been met on many railroads. It is, of course, difficult to arrive at figures for replacement costs on embrittled locomotives, although this has recently been estimated at $500,000 per year. These costs are probably of secondary importance in comparison with the desire to keep the locomotives in the best condition for service.

This situation has led to an intensive investigation of the embrittlement problem that has been generously supported by the Association of American Railroads, by several of the leading engineering organizations, and by the private industry, and by the Bureau of Mines.‡ From the study has come a coherent explanation of the process and the factors that allow embrittlement to occur in a riveted seam, devices that, attached to a locomotive, will determine whether or not the water can cause cracking, and chemical methods for feedwater treatment to make the water non-embrittling.

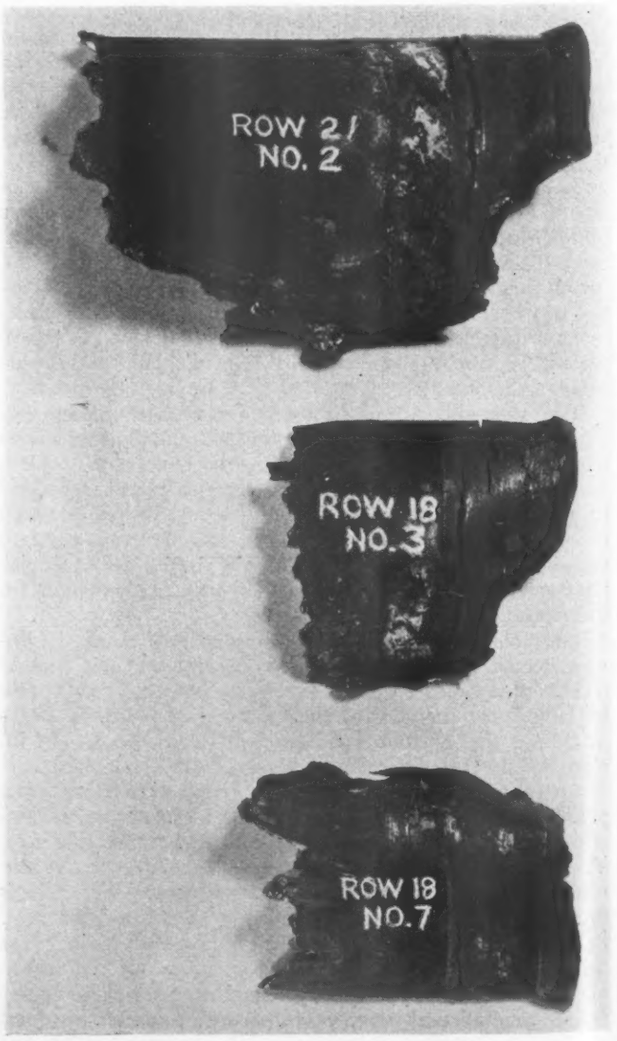
For many years the mechanism that allowed a solution to produce embrittlement or intercrystalline cracking was a profound mystery. Details are still not clear, but an explanation can be offered that will fit the experimental facts now available.

Chemical Action and Stress Must Be Present

It is well known that in many service conditions, steel will corrode or rust and that under more limited conditions this rusting will occur only at restricted points to produce deep holes or pits. Steel is made up of crystals held together by thin bands of material designated as grain boundaries and these boundaries are known to have different chemical properties from the crystals. Therefore, certain corroding solutions may exist that, instead of causing a random distribution of holes or pits over the metal surface, will confine all the attack to the grain boundaries, separating the crystals from each other and eventually allowing the metal to fail. As a very crude illustration, the action might be likened to the removal of the mortar from between the bricks in a wall, allowing the structure to collapse.

It is unfortunate that the very solutions that have been found most desirable in a boiler from the standpoint of preventing the rusting and pitting of the tubes and drum are the very ones most prone to cause embrittlement in the riveted seams. It is, therefore, desirable in many cases to establish the necessary conditions to prevent pitting and then add chemicals to prevent embrittlement.

Unlike rusting and pitting, however, embrittlement seems to occur only when the metal is under stress, and mainly stress in tension. These stresses arise from the structural load, from the steam pressure, or from cold work of the metal. Laboratory study indicates that this latter factor is of the utmost importance. The cold bending of a sheet to form a locomotive drum will at times introduce enough work stress to make embrittlement attack possible. Cold distortion of the metal during riveting of a seam may be even more severe.

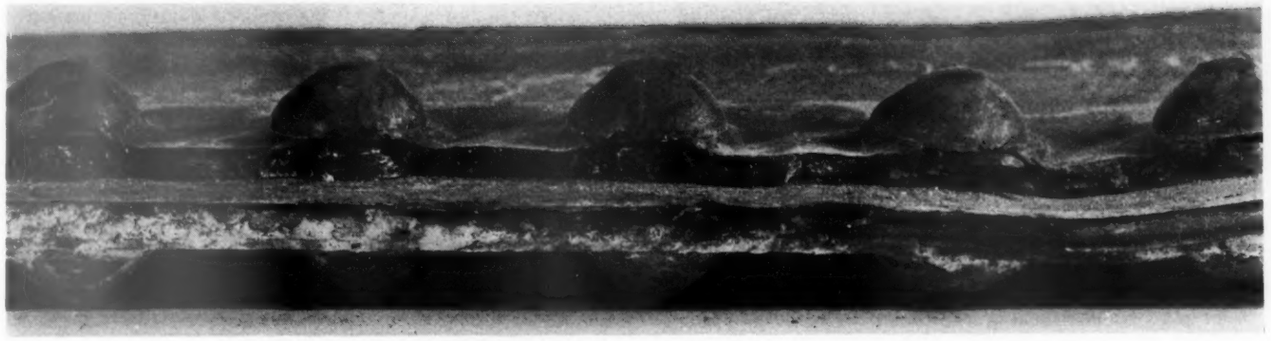


Embrittled tube ends from a watertube boiler

* An abstract of a lecture delivered before the annual meeting of the Master Boiler Makers' Association at Chicago on October 17, 1939, and published by permission of the Director of the Bureau of Mines.

† Senior chemical engineer, Eastern Experiment Station, Bureau of Mines, College Park, Md.

‡ An abstract of a report of the earlier investigation of this problem by the Bureau of Mines was published in the September, 1938, issue of *Railway Mechanical Engineer*.



Edge view of embrittled lap joint of caustic settling tank

To prevent embrittlement, the pressure and structural stresses in the seam should not be excessive and all possible care should be exercised to see that they are not localized, for a crack may be started from one point that will be difficult to stop. Above all else, however, the cold working of the drum, butt strap, and rivet metal should be kept at a minimum.

The author believes that careful design and fabrication of locomotive boilers can prevent a large portion of the cracking in spite of bad water conditions.

Concentration of the Boiler Water in the Riveted Seam

Contact of a normal locomotive boiler water with the riveted seam will not cause intercrystalline cracking. If there is a slight leak through the seam, deposits of solids are frequently seen at the outer edge and, when the seam is torn apart, are found between the drum sheet and butt straps as well as around the rivets. To create such deposits, which are made up of the so-called "soluble salts," the boiler water must concentrate several hundred fold. This concentrated solution in contact with the stressed metal is the one that causes embrittlement.

To produce concentration in this manner the leak must be very slow. One that can just be detected through the formation of a very faint haze of steam on a cold mirror held over the point of leakage is very dangerous. Such leaks are so small that they may not be detected during a cold pressure test on the locomotive.

A boiler that shows deposits of white solid at the seam edges may be in serious danger of embrittlement. Fabrication should make the drum just as tight as possible, for it is the speaker's belief at the pesent time that intercrystalline cracking cannot occur in a locomotive boiler in the entire absence of leakage.

The Embrittlement Detector

The embrittlement detector, a very simple device for direct attachment to a locomotive, has been developed to measure the embrittling action of the boiler water. The water circulates through a block, to which a specimen is clamped and a slow leak creates concentrated solution in contact with the stressed area of the specimen. If the water is embrittling, the specimen will crack. When this occurs, chemical treatment is added to the feedwater and the test repeated to prove that the water is non-embrittling. These devices are now in use on a number of railroads throughout the United States.

Combination of Four Factors Required for Embrittlement

Intercrystalline or embrittlement cracking is not due either to water conditions or boiler construction alone, but to a combination of factors that simultaneously create the following conditions: (1) A boiler water which, when concentrated, will produce embrittlement or intercrystalline cracking; (2) high stress in the metal, which may result either from cold work or externally applied stress; (3) formation of a film of concentrated solution as a result of slow leakage and (4) contact of the film of concentrated solution with the boiler metal in the region of high stress.

The first factor is in partial control of the chemist, the second probably depends on the design and workmanship used in the boiler construction, the third depends on the design and construction as well as conditions of service, while the last one would seem to be pretty much in the hand of fate.

Protection From Embrittlement

It should be possible to prevent embrittlement by eliminating any one of the four factors that have been listed. On locomotives already built and in service, the simplest and least expensive remedy seems to be water treatment. In the past, successful pursuance of this course has been impossible because of incomplete and, at times,

Embrittlement detector installed on a locomotive boiler

totally wrong information concerning embrittlement. Even at the present, feedwater-treating methods, while apparently successful, are still in the experimental stage. Fortunately, it is now unnecessary to wait until a locomotive boiler cracks to designate a water-treating method as ineffective, for a test run with the embrittlement detector will crack a specimen and give warning of dangerous conditions in a short time.

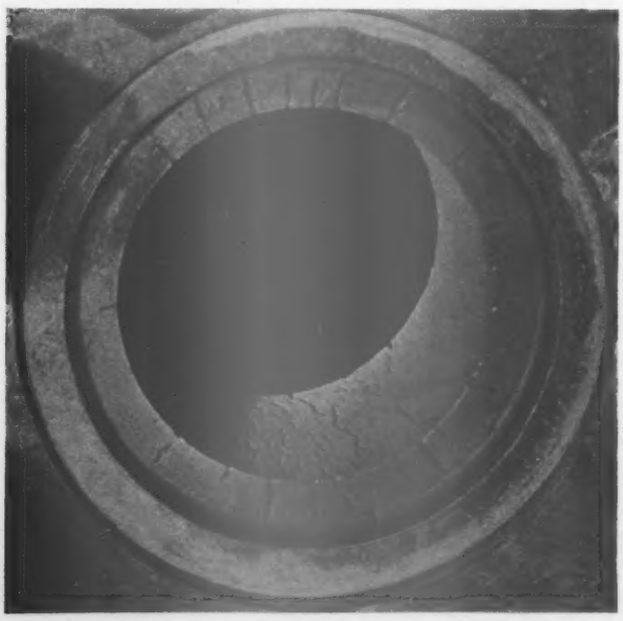
While water conditioning may prevent embrittlement, this offers not the slightest excuse for poor boiler design and bad workmanship that provides the other necessary conditions to start and promote cracking. In every case of embrittlement cracking, the boiler manufacturer should be willing to assume and shoulder his full responsibility where poor design, bad shop practices, or poor workmanship are evident.

The investigation at the Bureau of Mines has been so far largely confined to the study of chemical methods for treating the feedwater to prevent embrittlement. Some engineers have thought that sodium sulphate was satisfactory for this purpose, but this idea is not substantiated by laboratory work, nor apparently by railroad experience. A few organic chemicals have been found, however, that seem to be satisfactory protective agents.

The Use of Sodium Sulphate

As a result of a statistical study of stationary boilers, the conclusion was reached by a few engineers that maintenance of certain amounts of sodium sulphate in a boiler water would prevent embrittlement. A subcommittee of the Boiler Code Committee of the American Society of Mechanical Engineers later adopted this idea as the basis for the embrittlement code, in spite of the fact that the railroads had submitted statements indicating that their experience was apparently in disagreement with this belief.

In the past, a tendency has existed to interpret evidence from stationary boilers largely with the idea that if a water was embrittling the boiler would crack. Therefore, if an alkaline boiler water contained sodium sulphate and the boiler did not crack, this was taken as partial evidence that the sodium sulphate rendered the water non-embrittling. When applied to an individual case the present and clearer understanding of the embrittling problem makes apparent the fallacy of such reasoning. Even though the water is embrittling, the boiler will not crack unless simultaneously it develops, (1) leaks of just the right size to allow concentration to take place, (2) if certain areas of the boiler metal are highly stressed, and (3) if the stressed metal is in contact with the concentrated solution. Therefore, if the boiler does not crack this does not necessarily mean that sodium sulphate is protective, but may just as well mean that the boiler was well built and cracking would not have occurred in the entire absence of sodium sulphate.



External appearance of cracks believed to result from corrosion fatigue

It is certain that several factors are involved in the cracking of a boiler drum aside from the condition of the water. Therefore, it is going to be difficult, if not impossible, to isolate the effect of a given feedwater treatment in preventing cracks from a simple study of statistics on operating boilers. By use of the embrittlement detector, the cracking action of the water alone can be determined. Up to the present time even high concentrations of sodium sulphate have not stopped cracking of detector specimens in laboratory or plant tests.

Straub* has recently suggested that sodium sulphate and sodium chloride prevent embrittlement. Plant and laboratory tests with the embrittlement detector have not confirmed this idea at all.

The Use of Organic Materials

Extensive study has not yet revealed any inorganic compounds which are definitely without undesirable properties in a boiler and which at the same time will prevent embrittlement. Therefore, search for a material with these desirable properties has been made in the field of organic chemicals, with some degree of success.

In the pressure range normally used in locomotive operation, lignin-containing materials, as represented by waste sulphite liquor,†, will prevent cracking in detector specimens of boiler flange steel. Waste sulphite liquor is not expensive and its use on a considerable number of railroads has shown that it creates no operating difficulties. In several cases its effect on the embrittling action of the water is being closely followed with detectors attached to the locomotives. Practical tests of this type will furnish data of the utmost significance.

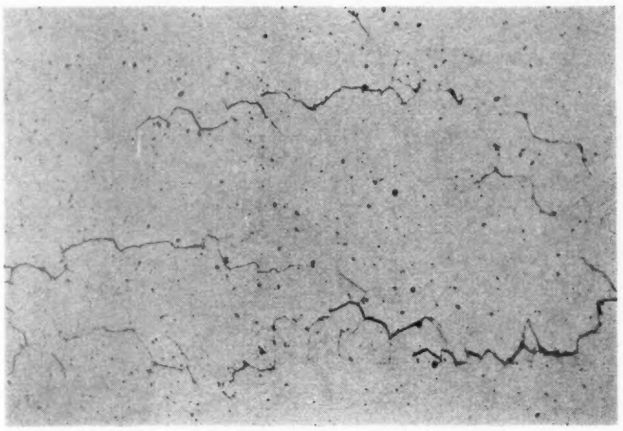
One American railroad, during the period 1912 to 1926, reported 221 engines cracked through embrittlement. In this latter year, lignin compounds were introduced into the feedwater in conjunction with an antifoam treatment. A decrease in cracking was noted and the treatment has been in continuous use since that time. From 1926 to 1938 only eight cases of engine cracking have been reported. At the present time the road is entirely free from difficulty and in view of the fact that laboratory tests show the lignin to be a good protective agent, it may be reasonable to assign the major portion of the improvement to the use of this compound. The author hesitates, however, to cite statistical evidence of this type since it is obvious that over a period of years, many changes might have been made aside from those in water conditioning. This whole case could be made a good deal clearer by the use of the embrittlement detector to determine the action of the waters before and after lignin treatment. It is hoped detector tests now under way on other railroads will demonstrate less equivocally the action of the lignin compounds.

Quebracho, another organic compound, has been found suitable in the laboratory for preventing intercrystalline cracking over the pressure range from 200 to above 500

* F. G. Straub and T. A. Bradbury. Boiler Water Treatment New Methods for Preventing Embrittlement. Mechanical Engineering, pp. 371-376, May, 1936.

† A waste product from the paper industry.

lb. It is effective not only in boiler flange steel but also in specimens that have been cold worked before insertion in the detector. In general, it is probably too expensive for use in locomotives, but it has been extensively applied in stationary boilers. Coupled with a powerful effect in preventing embrittlement it will also remove oxygen from the boiler water and apparently



Unetched photomicrograph of intercrystalline cracks

exert a marked dispersing action on solid particles precipitating in the boiler water.

In the past, one of the foremost objections to the use of organic material has been the lack of a chemical test for determining their concentration. This has been overcome by the development of a fairly rapid colorimetric method that may be used to estimate lignin-containing materials such as waste sulphite liquor as well as quebracho, and several other similar organic compounds. This method has greatly helped in the intelligent application of organic treatment for preventing embrittlement.

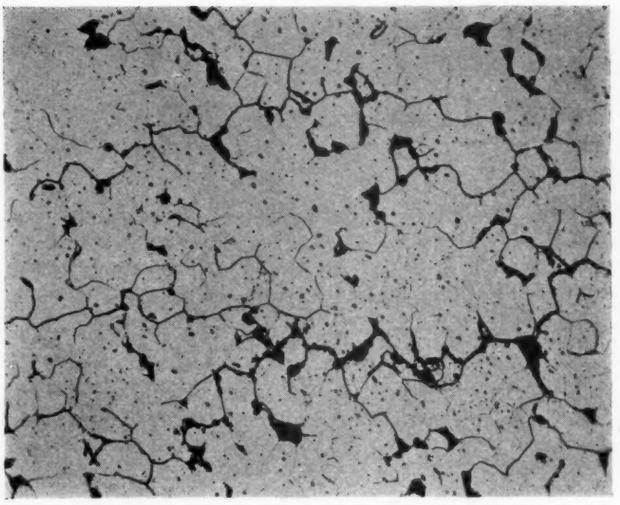
Conclusions

This lecture has attempted to develop, on the basis of information now available, a logical view point for the entire process leading to embrittlement cracking. The fundamental chemistry of the attack depends on the preferential corrosion of the grain boundaries with respect to the crystals of the metal, but it should be noted that stress is apparently a necessary prerequisite to produce dangerous cracking. Embrittlement is not caused by contact of the metal with a dilute boiler water but instead by contact with a solution resulting from concentration of the water as it leaks and permeates through the riveted seam.

For embrittlement to occur in a locomotive boiler, combined conditions must exist as follows: (1) an embrittling water, (2) high cold-work or applied stress in the metal, (3) leakage or concentration in the riveted seam, and (4) contact of the concentrated solution with the stressed metal.

These factors clearly indicate that only a portion of the problem is in the hands of the feedwater-treating chemist. The boiler manufacturer must bear his responsibility to see that design and cold work stress are kept to a minimum and that the seams are so constructed that they can be maintained essentially "leak free."

At the same time, since the embrittling or non-embrittling nature of the water is only one factor in the problem, it becomes difficult to interpret statistical data



Etched photomicrograph of intercrystalline cracks

from operating boilers to determine the effectiveness of a given chemical treatment in preventing cracks. This may indicate that incorrect interpretation has been applied to the cases which were believed to indicate that sodium sulphate would stop cracking. The old contention of several of the railroads that this salt was not satisfactory in locomotive boilers may then be correct, and furthermore is logical, since railroad observations are based on so many more units that the chances are much better for obtaining the combined conditions to favor cracking that will show the ineffectiveness of a given treatment. For instance, two railroads in the United States that have suffered most severely from embrittlement have a combined total of more than 3,000 locomotive boilers on which to base their observations. Individual cases of cracking will run well over 500 with approximately 400 engines involved.

The costly and undesirable method of measuring the ineffectiveness of a given treatment to prevent embrittlement by allowing a locomotive boiler to crack is perfectly apparent. Now, the evidence points strongly that this can be avoided by direct attachment of an embrittlement detector to the locomotive. At the same time, this unit will make it possible to classify the embrittling action of boiler waters, without introducing variables of boiler construction. To date, tests have not shown that sodium sulphate will stop cracking.

No inorganic salt or combination of inorganic salts has yet been found entirely suitable for use in the boiler to prevent embrittlement. Organic materials such as waste sulphite liquor and quebracho are apparently much more successful. At the present time the waste sulphite liquor seems most suitable in locomotive operation. A method of analysis has been developed to determine its concentration in the boiler water.

Present evidence indicates that waste sulphite liquor, found satisfactory for preventing embrittlement in the laboratory, may also have played a major part in the last 12 years in eliminating embrittlement on one railroad suffering from this problem in a most aggravated state. A second railroad has been using the material under controlled conditions for over a year with the evidence beginning to indicate a definite decrease in cracking.

With further laboratory testing as well as cooperative testing with the railroads, it is hoped to eliminate completely the embrittlement problem from railroad operation.

Illinois Central Builds Three

Heater Cars*

By H. Anderson†

THREE heater cars were constructed at the Illinois Central Burnside Shop, Chicago, in February for use in connection with the Diesel-electric switch engines, none of which is equipped to furnish steam to passenger cars. The new heater cars will be used in the Diesel engine handling of trains at Central Station, Chicago, in the cleaning yard, and for the turn-around.

The three heater cars were numbered HU 1, HU 2, and HU 3. They are of steel construction, having been built from the underframes and trucks of retired express refrigerator cars. The underframes were reduced in length from 40 ft. to 30 ft., before the construction was begun.

Each of these cars is equipped with the following units: two rectangular steel water tanks, two rectangular steel fuel-oil tanks, two Clarkson steam generators, two fuel and water pumps, two 3-hp. motors, one ¾-hp. motor, one air compressor, one steam-engine-electric generator set, one battery unit, electrical equipment for automatic operation of the system, two sets of steam coils for heating the car, a water treating tank for eliminating scaling in coils, and a small rotary converter for the ignition system.

Two 3-hp. motors operate the fuel oil and water pumps which furnish fuel oil and water to the boilers, also the blower fans. A small air compressor, operated by a ¾-hp. motor, furnishes 22 lb. pressure, which atomizes the fuel oil. The fuel is supplied from two tanks, 1,000 gal. total capacity, located at one end of the heater car.

The water is supplied from two tanks, total capacity of 4,500 gal., located in the opposite end of the car and to the sides, allowing passageway through the center of the car. The water from these tanks, which are connected with balancing pipes so that the water level is maintained equal in each tank, flows through the treating tank before entering the boilers. The steam generators are capable of raising and maintaining 240 lb. steam pressure two minutes after starting, and evaporating 1,600 lb. rated capacity of water per hour each, or 2,000 lb. maximum each, both generators having a rated capacity of 3,200 lb. per hour and a maximum capacity of 4,000 lb. of steam per hour, which is sufficient to keep 20 to 25 passenger cars warm at sub-zero temperature.

The system is started by a unit of eleven Idex batteries, less one cell, or the equivalent of eleven automobile batteries, less one cell, or 62 amp. hour, 64 volt capacity. These batteries start the small air-compressor motor and the two 3-hp. motors operating the fuel and water pumps and fans. When 150 lb. of steam pressure has been raised, steam is admitted to a small one-cylinder reciprocating steam engine of 2,100 r.p.m., which runs at 7½-kw., 64-volt generator, which in turn operates the above mentioned motors, relieving the batteries and at the same time recharging them.

The exhaust from the steam engine is carried through a fin radiation line on top of car for condensation, thence back to water tanks, thus conserving the water supply and preheating the water for the boilers.

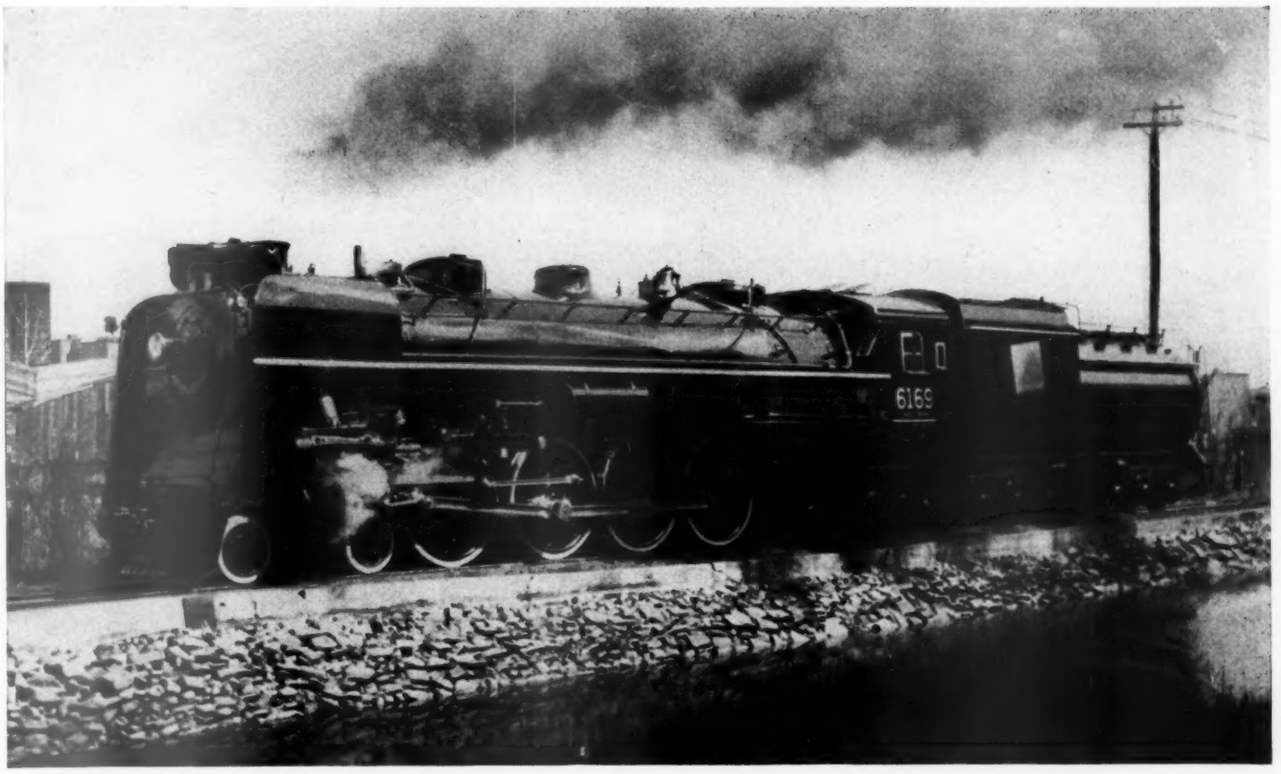
There is also installed at each side of the cars a steam coil for heating the car, which can be supplied from the boilers when in operation, or from a yard line when idle. The condensation from these coils also returns to the water tanks.

The piping system, steam, oil and water is installed inside of the car, with the exception of the steam train line under car, and the condenser, which is on top of the car. The entire system is installed, also, at a pitch, elim-

(*Continued on page 189*)

* Abstracted from the Illinois Central Magazine, April, 1940.
† Correspondent, Illinois Central Magazine.

Heater car built by the Illinois Central for use with Diesel-electric locomotives handling passenger equipment at terminals



Twenty-Five Improved Northern Type

4-8-4 Locomotives for C. N. R.

Locomotives for fast freight and heavy passenger service have tractive force of 56,800 lb.—Fifteen with boosters develop 10,300 lb. more

THE first of fifteen 4-8-4 locomotives equipped with boosters on the trailer trucks was delivered to the Canadian National on March 21 by the Montreal Locomotive Works, Ltd. Ten additional locomotives of the same design but without boosters are being built by the Canadian Locomotive Co., Ltd., Kingston, Ontario. The locomotives with the boosters are classified by the railroad as U-2-e's and have road Nos. 6165 to 6179, while those without boosters are U-2-f's and are assigned road Nos. 6180 to 6189.

These locomotives are similar in basic design to locomotives of the same type built for this railroad by the Montreal Locomotive Works, Ltd., in 1929. They have a maximum rated tractive force of 56,800 lb. with an additional 10,300 lb. developed by the locomotives equipped with boosters. All the locomotives have 73-in. drivers, 25½-in. by 30-in. cylinders, and the boilers carry a pressure of 250 lb. The total weight of the U-2-e engine is 402,700 lb. of which 240,800 lb. is carried on the drivers and of the U-2-f engine is 391,000 lb. with 238,000 lb. on the drivers. The locomotives have Baker valve gears with a 9-in. maximum travel. The U-2-e locomotives have a valve setting suitable for fast freight service while the U-2-f locomotives have a valve setting which makes them more adaptable for either fast freight or heavy passenger service. All of the locomotives are fitted with Barco type M-1 power reverse gears.

The tenders are of the Vanderbilt type having a capacity of 11,600 Imperial gallons of water and 20 tons of coal. The bottom of the tank is formed from a heavy plate which acts as the frame and to which are welded and riveted the draw and center castings. The stoker engine is housed in a compartment in the rear of the stoker trough which is of steel plate with cast-steel ends all welded into the tank structure. The tanks are carried on Commonwealth six-wheel trucks.

The boiler is of the straight-top type with three courses. The inside diameter of the first course is 80⅞ in., and the outside diameter of the largest course is 90 in. The firebox has a 48-in. combustion chamber and is equipped with two Thermic syphons and three arch tubes of 3-in. outside diameter. The boiler shell is made of silicon steel.

Improvements in Design

The design of the new locomotives has been modified to permit the installation of construction features which are regarded as improvements over the older locomotives of the same type. The steam passages to and from the

cylinders have been redesigned to remove restrictions to the flow of steam. Larger dry and steam pipes are employed, and the cylinders have been modified to obtain a more direct passage for the steam through steam and exhaust ports of greater area. The change in cylinder design has also made possible an increase in bolting surface between the cylinders and frames and between the cylinders and smokebox.

Table of Principal Dimensions, Weights, and Proportions of the Canadian National 4-8-4 Locomotives

Railroad	Canadian National	Canadian National
Builder	Montreal Locomotive Works, Ltd.	Canadian Locomotive Co., Ltd.
Type of locomotive	4-8-4	4-8-4
Road class	U-2-e	U-2-f
Road numbers	6165–6179	6180–6189
Service	Fast freight and passenger	Fast freight and passenger
Cylinders, diameter and stroke, in.	25½ × 30	25½ × 30
Weights in working order, lb.:		
On drivers	240,800	238,000
On front truck	67,800	68,800
On trailing truck	94,100	84,200
Total engine	402,700	391,000
Total tender	284,250	284,250
Total engine and tender	686,950	675,250
Wheel bases, ft. and in.:		
Driving	19–6	19–6
Rigid	12–8	12–8
Engine, total	43–10	43–10
Engine and tender, total	82–4¾	82–4¾
Wheels, diameter outside tires, in.		
Driving	73	73
Engine:		
Valve gear, type	Baker-Pilliod	Baker-Pilliod
Valves, piston type, size, in.	14	14
Maximum travel, in.	9	9
Outside lap, in.	1-5/16	1-9/16
Exhaust clearance, in.	3/16	3/16
Lead, in.	5/16	¼
Boiler:		
Type	Straight top	Straight top
Steam pressure, lb. per sq. in.	250	250
Diameter, first ring, inside, in.	80⅞	80⅞
Diameter, largest, outside in.	90	90
Firebox length, in.	126⅛	126⅛
Firebox width, in.	96¼	96¼
Combustion chamber, length, in.	48	48
Tubes, number and diameter, in.	42–2¼	42–2¼
Flues, number and diameter, in.	167–3½	167–3½
Length over tube sheets, ft-in.	21–6	21–6
Grate area, sq. ft.	84.4	84.4
Heating surfaces, sq. ft.		
Firebox	415	415
Tubes and flues	3,805	3,805
Evaporative, total	4,220	4,220
Superheater	1,884	1,884
Combined evap. and superheat	6,104	6,104
Tender:		
Type	Vanderbilt	Vanderbilt
Water capacity, gal.	11,600 (Imperial)	11,600 (Imperial)
Fuel capacity, tons	20	20
Trucks	6-wheel	6-wheel
Rated tractive force, engine, lb.	56,800	56,800
Rated tractive force, booster, lb.	10,300	....
Weight proportions:		
Weight on drivers ÷ weight engine, per cent	59.82	60.87
Weight on drivers ÷ tractive force	4.24	4.18
Weight on engine ÷ evap. heat. surface	95.4	92.7
Weight on engine ÷ comb. heat. surface	66.0	64.1
Boiler Proportions:		
Firebox heat. surface, per cent of comb. heat. surface	6.80	6.80
Tube-flue heat. surface, per cent comb. heat surface	62.34	62.34
Superheater heat. surface, per cent comb. heat surface	30.87	30.87
Firebox heat. surface ÷ grate area	4.92	4.92
Tube-flue heat. surface ÷ grate area	45.08	45.08
Superheat. heat. surface ÷ grate area	22.32	22.32
Comb. heat. surface ÷ grate area	72.32	72.32
Evap. heat. surface ÷ grate area	50.0	50.0
Tractive force ÷ grate area	673.0	673.0
Tractive force ÷ evap. heat. surface	13.46	13.46
Tractiveforce ÷ comb.heat.surface	9.31	9.31
Tractive force × dia. drivers ÷ comb. heat. surface	679.3	679.3

Arrangement of gages in cab illuminated by one light with reflecting guard

The application of SKF roller bearings has been made to all engine-, trailer-, and tender-truck axles. The main- and side-rod bearings have floating bushings on all the crank pins. Smoke deflectors of the side wing type have been installed on each side of the smokebox. Other features in which these locomotives differ from their predecessors include the use of the A. A. R. front-end arrangement and the application of a standard type HT stoker.

Special Equipment

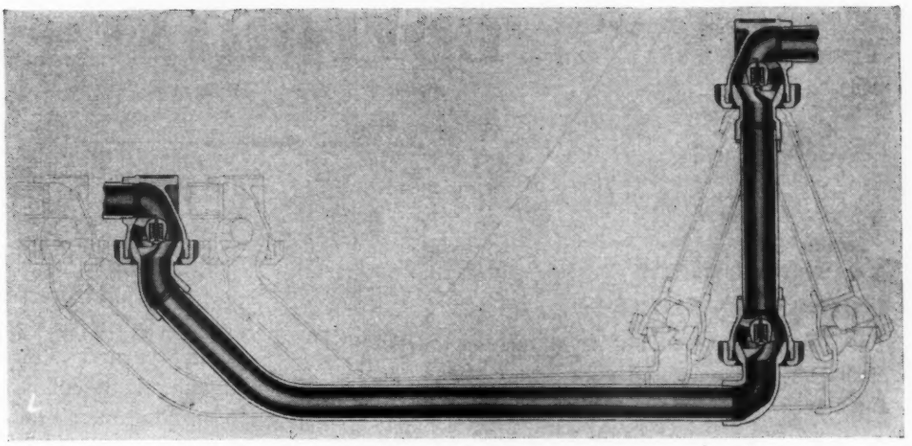
The locomotives have Elesco feed water heaters, C. F. pumps, Type E superheaters, American multiple front-end throttles and Tangential dryers. Hancock Type W nonlifting injectors are placed on the right side. Other special equipment includes constant-resistance engine and trailer trucks furnished by the General Steel Castings Corporation, Franklin unit safety bar and Type E-1 radial buffer.

The main driving boxes are equipped with the floating bushing bearings developed by the Canadian National while all other driving boxes have the standard crown bearings. The front drivers are fitted with the Alco lateral-motion device. The locomotives have Westinghouse cross-compound air compressors and ET brake equipment.

Barco Joints Improved

An improved design of metallic connection for air, oil, water and steam lines between locomotives and tenders has been announced recently by the Barco Manufacturing Company, Chicago. The new connections, known as the Type-3VX, include Type-X streamline joints, are interchangeable with the standard Barco 3V connections. If desired, therefore, the standard Barco connections now used on most of the railroads throughout the United States and Canada may be removed and the new 3VX connections applied without any alterations in the piping on the locomotive or tender and without any alteration in the brackets supporting these connections.

Some of the advantages of the new type connections for use between locomotive and tender are as follows: Only one gasket per joint is used, thereby cutting the gasket consumption by 50 per cent; the contour of the



New Barco Type-3VX locomotive-tender connection with improved streamline joints giving one-third greater flexibility

gasket has been changed somewhat to reduce the friction between the ball and the gasket and still further increase the life of the gasket as well as the life of the ball; all of the balls or metal wearing parts are hardened alloy steel forgings; heavy square threads are used to attach the nut to the casing instead of the old style V-threads, thus giving longer life to the threads.

The Barco 3VX joints provide 33⅓ per cent more movement with the same length of piping between the joints. No manual adjustment is required, and there is no possibility of tightening the nut so much as to cause binding of the ball between the two gaskets. The connections are hung vertically giving a free pendulum action. The stainless-steel springs, which are carred in a streamlined cavity in the casing, keep the spring seat on the exact center of the ball, so that the spring pressure keeping the ball and gasket in contact does not vary and is the same in all positions as the balls flex.

These joints and connections are said to have been tested on air and steam lines since August, 1937, with satisfactory results and are now being applied between locomotive and tender to the 10 new locomotives being built by the Chicago, Burlington & Quincy at West Burlington, Ia., and between engine and tender and the articulated unit of the 20 Mallet locomotives being built by the American Locomotive Company for the Delaware & Hudson.

Truck-Spring Snubbers

(*Continued from page 179*)

On the other hand, you will note how the harmonic action of the all-coil group built up over-solid blows amounting to the maximum that the instrument could record. These maximum blows represented forces 39,540 lb. over the solid spring-group capacity. Note the number of additional blows that registered forces from 10,000 lb. to 30,000 lb. over the solid capacity of the group.

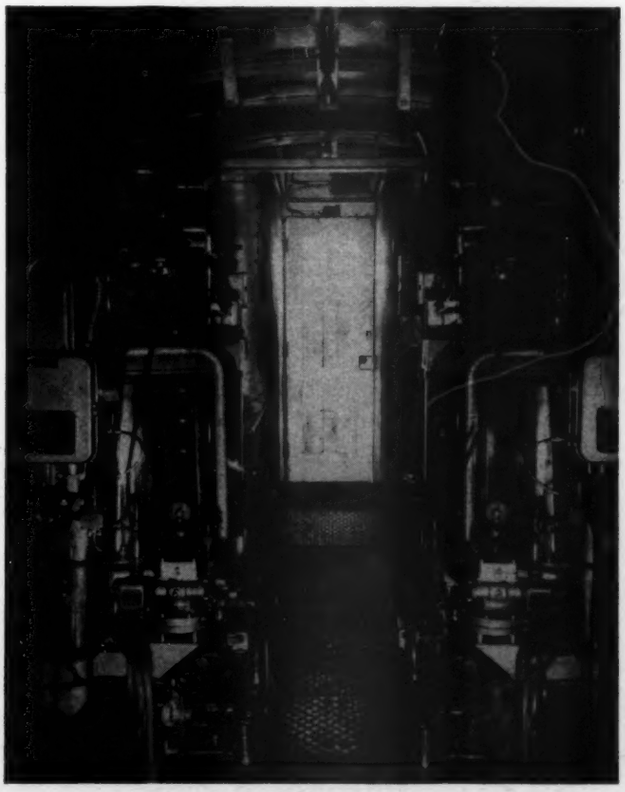
Any car maintenance items that are caused by springs going solid or by the jittery bouncing around of empty carbodies on spring groups that are too stiff will unquestionably be greatly reduced, if not entirely eliminated, by the use of truck-spring snubbers and, when you stop to consider how many car maintenance items can be effected, you will more completely realize the necessity for the use of truck-spring snubbers from a maintenance standpoint.

Illinois Central Builds Heater Cars

(*Continued from page 186*)

inating all water pockets and furnishing complete gravity draining.

The entire system is operated automatically with electrical devices, including the electric eye, which in 90 seconds will shut off operation should there be a fire failure; a high temperature switch which shuts the boiler down if the steam becomes superheated, and a stack switch which shuts the boiler down should there be excessive heat exhausting through the stacks. So, in case any portion of the system should fail of proper operation, it is automatically shut off and a gong is sounded, warning the attendant.



Interior of the heater car showing the two Clarkson steam generators

EDITORIALS

Technological Unemployment

There is no question but what technological improvements have made possible the more rapid opening up and development of the vast resources of this country. This has resulted in an unusually high standard of living for the American people, including even those in the lower income brackets. It is true that much still remains to be desired for those in the less fortunate groupings, but even as it is, their lot is far better than that of people similarly placed on other continents.

Because of the intense and long-continued depression that has extended over the past decade, much criticism has been directed against technological development, the charge frequently being made that it was largely responsible for the unemployment situation. As a result, a great deal of thought and study, much of it rather crude and spasmodic, but some of it on a scientific basis, has been given in the attempt to find how conditions might be so controlled as to minimize or largely do away with technological unemployment. Incidentally, for a time at least, engineers and scientists were under the cloud and were subjected to the harshest sort of criticism. As more sane thinking prevailed, however, they were absolved of much of the blame that had been attributed to them. So far as technological unemployment is concerned, about the worst that could be said is that the development of science and engineering has far outstripped the advance of the social sciences.

Government, in the guise of the Temporary National Economic Committee of Congress, has taken a hand in the matter, and Senator O'Mahoney's committee, ordinarily referred to as the Monopoly Committee, has been holding all sorts of hearings—from highly specialized industry investigations to the broad question of patents. It is also the sponsor of a considerable number of individual monographs on all sorts of economic questions; these are now in course of preparation. How much good will result from a political investigation of this sort remains to be seen. Incidentally, it is placing an immense amount of material of all sorts on record and it has undoubtedly challenged a considerable amount of hard thinking in some quarters.

The Brookings Institution of Washington, with funds granted by the Maurice and Laura Falk Foundation of Pittsburgh, has been making a more serious, scientific study of the problem of the distribution of wealth and income in relation to economic progress. The sixth of a series of books or reports, entitled, "Productivity, Wages and National Income," by Spurgeon Bell, has just been published. In its researches into the question of the extent to which labor, capital and the public have profited from increases in productivity, it finds that the gains to labor have proved to be chiefly in the form of greater leisure. On the other hand, the earnings on capital investment have declined. The gains accruing to the consumers in the terms of real goods and services, have been considerable. In other words, the consumers have gotten more goods for their money.

The last part of the report is concerned with the question: "Would the passing of the savings from increasing productivity to consumers generate an expansion of purchasing power?" The price of the products would be decreased making them more widely available. Since the wage and salary groups and those who contribute capital form so large a part of the consuming population, they would naturally automatically profit from the price reductions and would be able to buy a larger amount of the manufactured products. Moreover, both labor and capital would benefit from the expansion of aggregate production and aggregate employment. While the passing on of the benefits of increased productivity through the medium of price reduction would not prevent unemployment, it would undoubtedly greatly decrease it and would tend to stabilize employment.

Such studies as this are greatly to be commended. It is only by assembling all the facts and drawing logical conclusions from them that the representatives of labor and capital can intelligently get together and cooperate in such a way as to foster their mutual interests. Incidentally, this is bound at the same time to benefit the general public.

Brake Instructions For Division Officers

For the past eleven years the Kansas State Board for Vocational Education has conducted air-brake classes for railroad men as a part of its regular program. During this time 15,000 men have been enrolled in classes which have been held at twenty-five railroad division points within the state. The work has been conducted by two conference leaders. Chalk-talk lectures are the teaching medium. For the past five years the season's work has culminated in an annual conference of several days' duration, held at some central point, with an intensive educational program of morning, afternoon and evening sessions.

During February of the present year a unique feature was added to this program. This was an air-brake con-

ference for superintendents, assistant superintendents and train masters, in the arrangements for which the Wichita Board of Education cooperated with the State Board for Vocational Education. Fourteen superintendents, assistant superintendents and train masters from five railways, coming from points in five states, attended morning, afternoon and evening sessions for two days, in which conferences were alternated with lectures of an educational character dealing primarily with brake fundamentals and problems of the operating officer in matters of train-handling practice, discipline, federal inspection, etc.

The officers and supervisors of the mechanical department have long been accustomed to consider the air brake and all its problems as belonging quite exclusively to them. In matters of maintenance and details of the functioning of the various triple and control valves the monopoly of the mechanical department is not likely to be challenged. There is every reason, however, why division officers having to do directly with train movement should understand the functions, the limitations and even the most common sources of failures of the air brake equipment in their trains. Those men who have come up directly from the train service, no doubt, have a good background knowledge and even skill in train handling. Not all division officers have this background, however, and even those who do have it can benefit from an occasional period of intensive instruction on the newer types of brakes which are now coming into service. The conference sessions at which problems of the supervisors can be propounded and discussed should be of even greater value to men in such positions than the strictly instructional part of the program. Two days in a conference of this kind could be well spent by division officers and supervisors every year.

Flame-Hardened Stoker Screws

The abrasive action on the blades, or flights, of conveyor screws used in locomotive stokers is exceptionally severe and many railroads exercise notable ingenuity in developing ways and means of rebuilding the worn flights to their original size and hence reclaiming stoker screws for further service. The only caution which needs to be observed in this connection is to make sure that, considering all the various items of labor and material costs of reclamation, the time the stoker is kept out of service and the probable further service life of the reclaimed stoker screw, it would not be cheaper to buy a new one.

Based on some observations in the industrial field, the thought has been advanced that possibly the effective service life of locomotive stoker conveyor screws could be increased, and the time when they need extensive repairs substantially lengthened by flame-hardening the flights. According to a recently published article, the only equipment necessary for this job is a lathe or other convenient means for turning the conveyor screws on centers, a standard welding blowpipe and a small water supply line for quenching purposes. The progressive method of flame-hardening is employed, the operator handling both the blowpipe and the quenching water hose, while an assistant turns the stoker conveyor screw by hand. The blowpipe tip is held from ½ in. to ¾ in. away from the outer edge of the flight and the quenching water supply pipe follows the blowpipe as closely as possible without actually interfering with the flame. Thus heating and quenching are carried on simultaneously, proceeding slowly along the outer edge of the flights from one end of the screw to the other. The heating of the steel just above the critical temperature and the subsequent cooling produces a hardening effect approximately ⅛ in. deep over the entire outside diameter. A metal trough placed below the conveyor screw serves to catch and drain off the water.

Possibly this method of securing increased service life from stoker conveyor screws is now being used on one or more railroads, but if so, *Railway Mechanical Engineer* has not heard of it and would appreciate receiving information describing in some detail how the work is carried out. Presumably, the extent of the hardened area can be governed by controlling the amount of heat supplied by the blowpipe and the volume of quenching water applied. It is logical to ask how wide a hardened area would be desirable and also how much the hardness can be safely raised without sacrificing some degree of toughness and necessary strength. Another query which might be worth investigating is regarding the possibility of mounting both the blowpipe and the quenching water supply on a special carriage with feed adjusted to the pitch of the conveyor screw.

One general observation may be made in connection with this and other similar jobs and that is that if they are being handled with satisfactory results in general industry, there is more than an even chance that they may be profitably adapted, to some degree at least to railway practice. In the ever-present urge for economy in railway shop operation, aggressive mechanical officers will not overlook any opportunity to find out what the "other fellow" is doing and which of his methods can be applied to advantage in reducing the cost of car and locomotive maintenance work.

Why Should Diesel Repair Costs Be High?

Within recent years, during the time that Diesel-electric locomotives really have been installed in road passenger service, many persons have expressed skepticism concerning the chances for the ultimate success of that form of power. In this respect, the Diesel-electric

shares a situation which has confronted practically every major development that has been introduced in the railroad field. It is but natural to question that which is new and radical. Fortunately, the development of this form of motive power was predicated on a real need and its future will depend almost entirely upon how well it may be able to solve a problem that is economic rather than engineering in character.

A number of reasons have been advanced as to why the Diesel-electric might cost more or less than steam as a means of moving trains and, over a period of 10 years, the factors of wages, fuel, maintenance, lubrication, supplies and enginehouse expense have been discussed pro and con until we are actually approaching the time when experience may answer the questions. It is not the purpose here to become involved in any consideration of the items that make up the cost of operation of either Diesel or steam power other than the single item—cost of maintenance.

The cost of maintenance of any type of motive power includes the normal every day repairs made as a result of inspections before and after each trip, as well as the major repairs that are made when a locomotive has to be given a general overhauling. Maintenance cost also includes the expense of making inspections. In the case of the steam locomotive it is the traditional practice to shop it at intervals usually governed by mileage or length of service and make such general repairs, in many cases actually a rebuilding job, as will condition the unit for another term of road or yard service. In the case of the Diesel-electric the maintenance practice must be considered with due respect to the character of service in which it is used. Switching power, which has now been in service on some roads for 15 years, is being maintained in much the same manner as steam power; that is, it is being given general repairs at periods varying from one to two years. Road locomotives will undoubtedly follow much the same general plan when a sufficient number of them have been in service long enough to determine the most economical methods to be used. There is an essential difference in the repair practices relating to steam and Diesel in that one is in the nature of a rebuilding job, wherein major parts are manufactured in railroad shops for application to the unit undergoing repairs, and the other—the Diesel—is practically a parts-replacement job involving the renewal of standardized parts secured, for the most part, from the manufacturer of the original equipment.

Before there can be any consideration of maintenance costs the basis of determining costs and the manner of expressing costs must be established. It might be well to point out at this stage of the discussion that Diesel-locomotive operating costs are being kept by most roads on the basis of individual units—a basis of cost keeping that has rarely been considered practical with respect to steam power. There can be a vast difference between the maximum and minimum costs of the individual units in a group of, say, 50 locomotives and the average cost of the entire group. Therefore, in any consideration of comparative costs this factor should should be recognized.

It has been customary to use the per-mile figure as a measure of steam-locomotive costs. Practically all roads using Diesel switching power are recording operating costs of that type of power on a per-hour basis whereas such costs relating to steam power have been, until recently at least, on a per-mile basis, using an arbitrary six-miles-an-hour figure as a means of determining the mileage. Now we are beginning to see cost figures of Diesel road locomotives indicated on the mileage basis. In that respect Diesel costs may be directly compared to steam in spite of the fact that the comparison, once made, means very little unless it is related to the many conditions surrounding the character of service for which the motive power units are used.

Many railroad men have expressed the opinion that the maintenance costs of Diesel locomotives would probably be much higher than steam, so the question is asked, "Why should Diesel repair costs be high?" The plain fact of the matter is that when an analysis is made of the various factors involved in the maintenance of Diesel locomotives, as compared with steam or straight electric power, there is no good reason to believe that Diesel costs should be as high as either steam or straight electric.

In order to explore this suggestion a little farther it might be worth while to use some figures. For road power only a good figure for steam locomotive repair costs would be from 15 to 25 cents per mile. This includes both passenger and freight power. If the cost of repairing passenger power only could be segregated and related to the greater utilization and mileage in that class of service it is possible that a much lower average per-mile figure would result. On the other hand the costs of repairs for individual units, in exceptionally high-speed service might be very much higher. For electric locomotives, four roads handling a large volume of both freight and passenger traffic report locomotive repair costs varying from 11 to 25 cents a mile, with an average, for one recent year of 15 cents a mile. Diesel-electric road locomotive repair costs recently reported by one road are 11 cents a mile. It is admitted that the very meagre amount of Diesel cost data available justifies hesitation in making comparisons.

One thing is certain. In order to determine beyond question what type of motive power is best suited to a given set of operating conditions the railroads are now faced with the necessity of keeping costs in greater detail than has heretofore been considered necessary. The answer to the specific question raised in this discussion can not be arrived at on the basis of the data available at present. Experience so far does seem to indicate, however, that Diesel repair costs probably will not be as high as many railroad men once thought they would.

New Cabooses Built at Milwaukee Shops

During 1939 the Chicago, Milwaukee, St. Paul & Pacific built at its Milwaukee, Wis., shops, 75 new cabooses which are notable for their attractive appearance, easy-riding qualities, neat and bright interiors and the provision of all facilities essential to the comfort and convenience of train crews and hence contributing to the easier and more satisfactory performance of their work. From the point of view of external appearance, it cannot be questioned that these cars are a source of favorable publicity for the Milwaukee road.

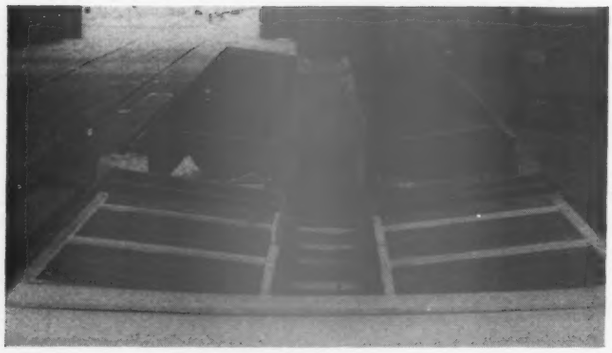
In accordance with what has come to be standard Milwaukee practice, the new cabooses have side-observation bay windows which enable trainmen, while seated at normal floor level, to obtain an excellent view along the full length of the train, especially when rounding a curve on the side from which observations are being made. The conventional type of cupola, now in general use on older cabooses on the Milwaukee and other roads has been shown by experience to have a number of disadvantages which the new type of bay window is designed to overcome. In the first place, with a high box or automobile car coupled next to the caboose, the trainmen's vision of what is going on up ahead in the train is almost completely blocked and frequent use must be made of the side windows in the cupola to make sure that no unsafe conditions are developing on the train. The old cupolas are also difficult to maintain rigid and free from air leaks, and consequently they are sometimes hard to heat to a comfortable temperature. While the physical effort and time involved in climbing up into and down out of a cupola would not ordinarily be significant, under certain conditions, it might be of vital importance. All of these more or less objectionable features of the caboose cupola are overcome by the side-observation bay windows now being installed on new Milwaukee cabooses.

Each of the new cabooses built at Milwaukee shops in the 1939 program is 35 ft. 3¼ in. long over the striking castings, and has a light weight of 38,800 lb. The inside width is 8 ft., which is increased to 10 ft. at the bay section, each bay, therefore, projecting 12 in. beyond the normal car side. The maximum outside width

The completed caboose ready for service

Left: Inside of a finished caboose—Right: Interior side insulation and top floor under which cork insulation is applied

Right: The roof welding jig —Below: Placing the insulation and ceiling panels



Principal Dimensions of 75 New Cabooses Built at Milwaukee Shops in 1939

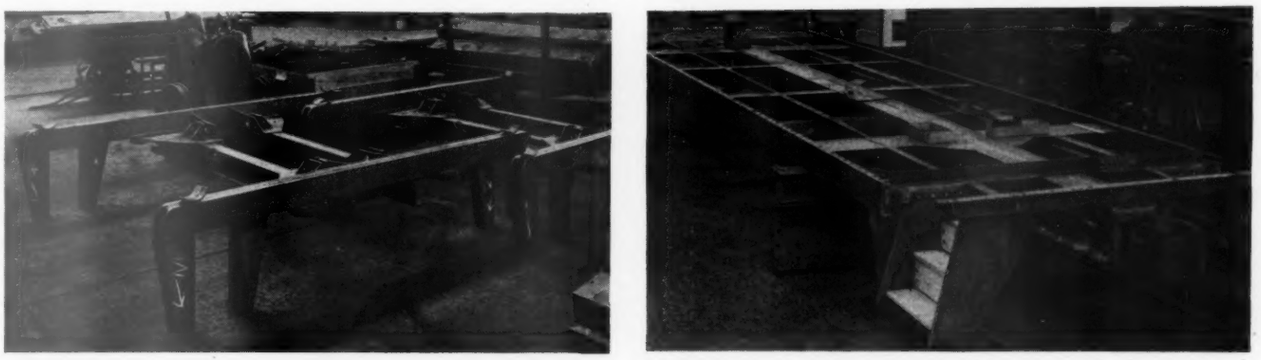
Length over striking casting, ft.-in.	35- 3¼
Length over running boards, ft.-in.	36- 0
Inside length, ft.-in.	28- 0
Inside width, ft.-in.	8- 0
Inside width—bay, ft.-in.	10- ⅛
Height—side sill to rail, ft.-in.	2-10 13/16
Truck centers, ft.-in.	19- 1½
Width over side sills, ft.-in.	8- 6½
Width over side frame, ft.-in.	8- 7½
Width over side frame—bay, ft.-in.	10- 8
Width over eaves, ft.-in.	8- 7 13/16
Height—top of rail to body center plate, ft.-in.	2- 1¾
Height—top of rail to floor, ft.-in.	3- 8⅝
Height—top of rail to eaves, ft.-in.	10-11 5/32
Height—top of rail to running board, ft.-in.	11- 8¾
Height—top of rail to top of ladder stile, ft.-in.	12-10¼
Height—top of rail to top of bay—outside, ft.-in.	9- 9 17/32

Side, roof, and running-board jigs

is 10 ft. 8 in. The inside height at the car sides is 6 ft. 11 in. The four-wheel trucks, supported on 4½-in. by 8-in. journals, are equipped with drop equalizers and a combination coil and elliptic spring arrangement designed to assure easy riding.

The car is of all-welded construction, the center sills being A. A. R. section, with couplers, yokes, draft gears and air brakes meeting the builders' standards for caboose equipment. The car is well insulated and equipped with necessary lockers, stove, lights, two reversible observation seats, three seats with 2-ft. by 6-ft. cushions, toilet and wash facilities. The inside finish of the car is plywood. In one corner of the car between the stove and the end of the car is the coal bin, a drain board, sink, cooler and ice box. On the opposite side at this end is placed a roomy locker with two compartments, the upper being used for oil cans and lanterns and the lower for jacks and brasses. The air gage is located well up on the wall of this locker where it can be readily seen and the emergency valve is conveniently located adjacent to the gage.

Referring to the illustrations, the general method of constructing these all-welded steel cabooses at Milwaukee shops will be apparent. In the large illustration on page 194 the complete side welding jig is shown in the foreground, roof jig in the rear and running-board jig at the right. The roof welding jig is shown at the top of the page, the general method of assembling the roof section sheets preparatory to welding, being clearly indicated. In the other view the roof is seen in the inverted position ready for the application of roof insulation and plywood ceiling panels. The underframe welding jig, shown on the next page, is used in assembling the center, side and end sills, bolsters and crossbearers in the up-side-down position to facilitate welding. The underframe is then placed right side up to complete welding, and the step treads are applied. The truck frames are completely fabricated by welding.



Above left: Truck frames are fabricated by welding—Above right: Where underframe welding is completed—Below: Underframe parts are welded in a special jig

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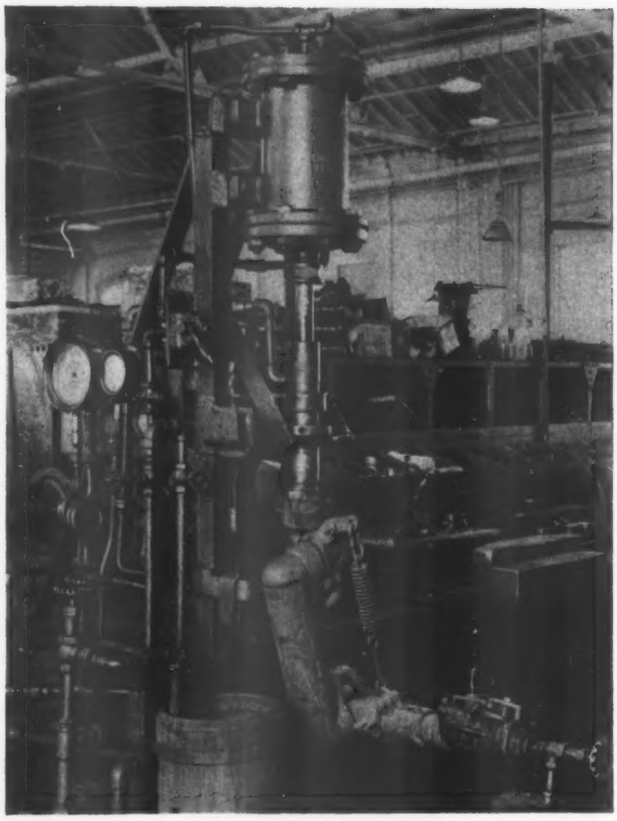
TRAVEL ON "400" INCREASES.—Passenger travel on the "400" operated by the Chicago & North Western between Chicago and the Twin Cities, showed an increase of 53 per cent for March, 1940, as compared with the same month in 1939 before the present streamline equipment was placed in service. From October 1, 1939, through February, 1940, total revenue increased 51.9 per cent over the corresponding period in 1938-39, the totals being $458,653 and $301,901, respectively.

Test Rack for Steam-Heat Connectors

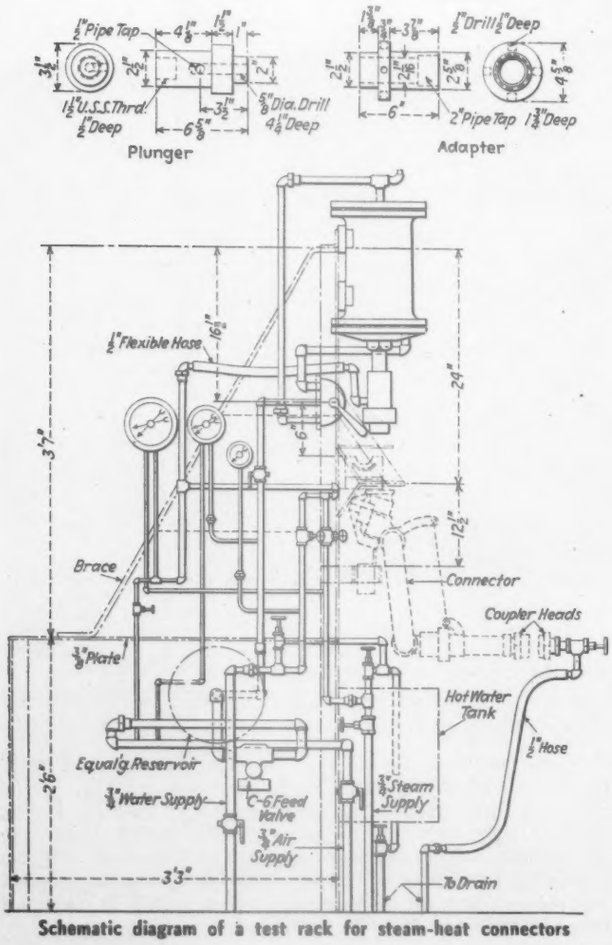
A test rack developed by the air-brake department at the West Albany car shops of the New York Central to expedite the testing of Barco and Vapor steam-heat connectors is shown in the accompanying photograph and schematic diagram. The arrangement permits the connectors to be quickly tested under steam pressure and then rapidly cooled by water to a temperature at which they can be handled.

The test equipment is supported by a table and frame fabricated of steel angles and plates by electric welding. A 5-in. double-acting air cylinder with a steel plunger attached to its piston rod is bolted to the top of the frame in a vertical position. The plunger has two functions. It makes a steamtight joint with the steam-heat connector under test, and it is the means through which steam and water enter the connector. The details of the plunger are shown in the drawing. The plunger has a ⅝-in. hole bored a little more than half way through its center axis. A hole is drilled from the side of the plunger to its center and is tapped to receive a pipe connection through which the steam and water is supplied. Because of the movement of the plunger, a ½-in. flexible metallic hose is introduced between the pipe connection on the plunger and the supply pipe.

The air for operating the air cylinder comes from the shop air line through a feed valve which reduces the pressure from 140 to 60 lb. per sq. in. After passing through the feed valve, the air is stored in a 10-in. by 14½-in. equalizing reservoir in order that a sufficient volume of air at the reduced pressure will be available when required. A locomotive sander valve is employed as an operating valve to control the movement of the air piston. The air, steam, and water pressures are indicated by the gages mounted at the side of the unit.



Testing a Vapor steam-heat connector in the rack



Schematic diagram of a test rack for steam-heat connectors

The bracket directly under the air cylinder supports the connector while being tested. The Barco connector rests directly on this bracket, but it is necessary to screw an adapter on to the Vapor connector which rests on the bracket when this type of connector is tested. The details of the adapter are given in the diagram. The Vapor connectors are also supported by a lower bracket as can be seen in both illustrations.

The tank at the bottom contains hot water in which ferrules are heated in order that the gaskets may be readily removed. After heating, they are placed in a bracket in which they are held while the gasket is removed. This bracket may be seen in the photograph directly beside the top connector support.

In operation, the end of the steam-heat connector or the adapter is placed on the support below the air cylinder, and the piston is lowered until the plunger makes a steam-tight joint with the connector, and is held in this position by the control valve. A coupler head is attached to the other end of the connector. This coupler head is fitted with a valve and hose through which the steam and water can be controlled and discharged. The water valve to the intake line is shut off and the steam valve is opened to admit steam through the flexible hose and the plunger to the connector. The connector is tested under steam pressure, after which the steam supply valve is closed, and the steam is discharged by opening the valve in the coupler head. Then, water is admitted to the connector and allowed to flow through until the temperature is reduced to a point at which the connector can be conveniently handled.

Sash Cleaning and Glazing Methods

The Point St. Charles car shops, Montreal, Que., of the Canadian National utilize two labor-saving devices for the removal of old putty from window sash being reconditioned and to reputty the sash after the application of the glass. Fig. 1 shows a bench drill equipped with a special cutting tool for cleaning old putty from sash and Fig. 2 illustrates an air-operated sash-glazing unit.

The special tool for cleaning the old putty from the sash has four cutting edges faced with ⅛-in. Carboloy as shown in Fig. 3. This cutter is assembled on a ½-in. rod with a bushing of $^{31}/_{32}$ in. diameter inserted between the cutter and the holding nut. The function of the bushing is to act as a guide for the cutter and prevent the operator from cutting into the sash. It insures the cleaning only of the width of the sash edge on which the glass is supported. It is, of course, necessary to remove the old putty from a small area in the corners by hand as the circular cutter can not reach these points.

A wood frame has been erected around the bench drill as a support for the sash and over which the sash may slide as the old putty is removed. The special cutting tool, assembled on the rod, is held in the drill by a chuck.

The sash-glazing device for applying new putty which is shown in Fig. 2 consists essentially of a cylinder filled

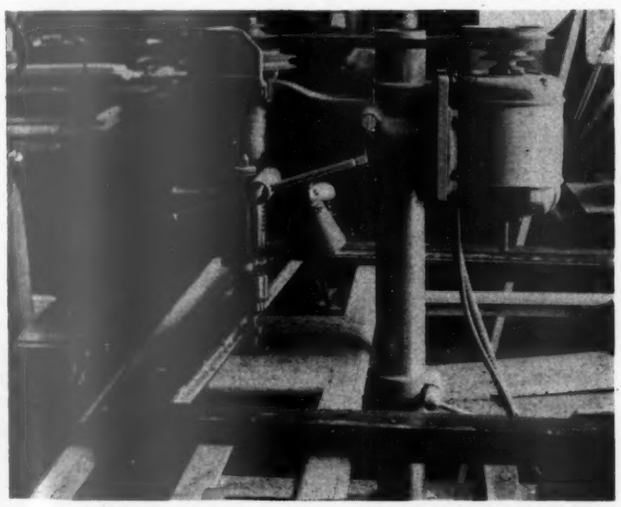


Fig. 1—The vertical bench drill equipped with a special tool for cleaning old putty from the sash

with putty which is forced through a flexible hose and nozzle by air pressure acting on a piston. The cylinder has 5⅞ in. inside diameter, a straight circular section of 15⅞ in. length at the top, and a conical section, 5½ in. in length, at the bottom ending in the outlet to the flexible hose. A water jacket, open at the top, surrounds the inside putty cylinder. The jacket cylinder is made of $^{1}/_{16}$-in. steel with an inside diameter of 11 in. and is welded to the inside cylinder at the bottom of the conical section. In the water space are coils of ¼-in. pipe encircling the inside cylinder through which steam passes to heat the water. The hot water heats the putty and keeps it in a state plastic enough to be forced through the cylinder and hose.

The ⅝-in. piston rod extends through a packing gland

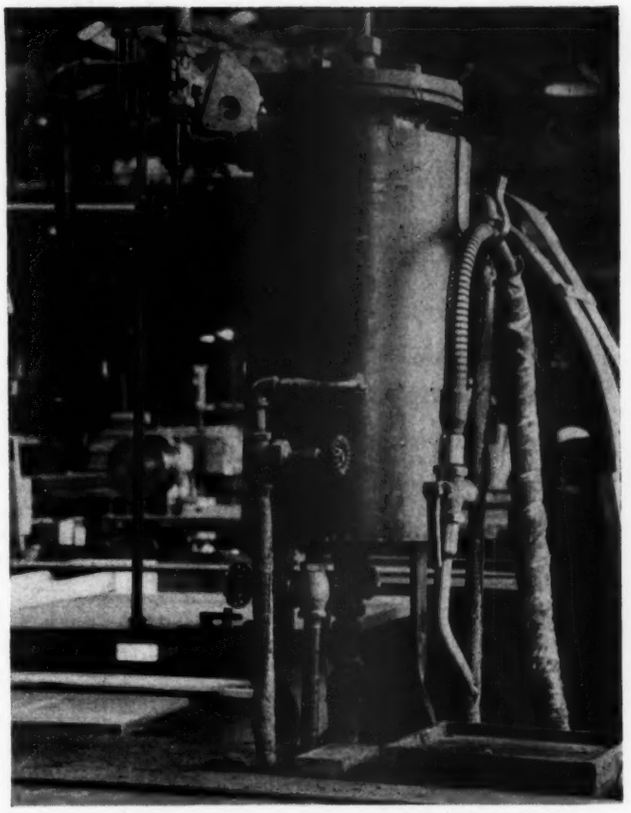


Fig. 2—Sash-glazing device for applying the putty

in the cylinder head and at its upper end is a weight which keeps the piston head down against the putty at all times. The weight is located so as to act as a stop when it reaches the top of the stuffing box and thus limit the piston travel. The flexible bronze hose is 7 ft. long and has a ¾-in. inside diameter.

The air supply is through a ¾-in. line and passes through a main control valve before entering the cylinder 1¾-in. from the top. The air pressure is indicated by a gage mounted on a bracket near the top of the unit. The air in the cylinder may be released through a ½-in.

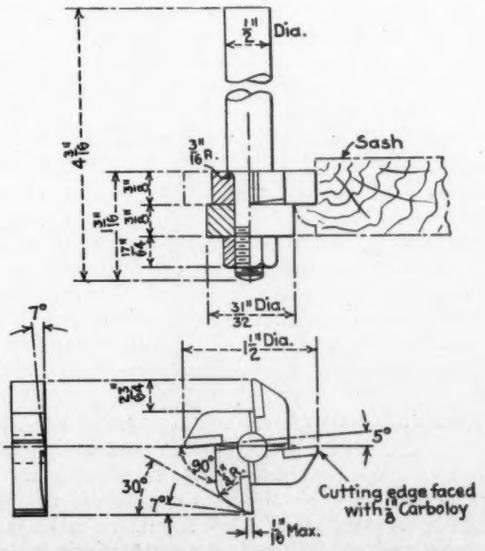


Fig. 3—The special cutter used with the vertical bench drill for cleaning putty from the sash

pipe tapped into the air intake line. A ¾-in. cock is at the outlet of the putty cylinder and between this cock and the flexible hose coupling is a pipe tee through which air is supplied to clean out the hose and prevent its stoppage by the setting of putty remaining in it for long intervals of time.

The control valve at the nozzle can be adjusted to regulate the rate of flow of the putty. The sash glazing device not only permits the putty to be applied quickly but makes possible the distribution of the putty in the exact amount required for any sash.

Air Brake Questions and Answers

D-22-A Passenger Control Valve (Continued)

570—*Q.—What maintenance improvement is obtained by this design?* A.—While serving as a lock, the spring also acts to maintain a positive contact between locking surfaces, thus avoiding loose movements and resultant wear.

571—*Q.—How are the pipe connections made to all operating devices of this equipment?* A.—By means of re-inforced pipe fittings of the flanged-union type.

572—*Q.—For what purpose are these fittings used?* A.—To produce iron, steel or copper pipe joints which can be maintained air tight and at the same time avoid failures in road service due to breakage of pipe or fittings. The fitting is designed to clamp the pipe back of the threaded end of the iron pipe so as to relieve the threads of tension stresses, and is so arranged as to permit ready removal and re-application.

573—*Q.—Why is it important that these fittings be correctly installed?* A.—If not, the protection against pipe failures at the point of the exposed threads may be lost.

574—*Q.—What is the correct method to follow when applying pipes with these fittings?* A.—After slipping the clamp nut and anchor ring over the threaded end of the pipe, the flanged fitting must be screwed on the pipe so as to make a rigid and air tight joint at the threads when the bolt holes are in line with the tapped holes in the face to which it will be bolted. The anchor ring and clamping nut must then be moved into place and the nut firmly tightened so as to close the anchor ring solidly on the pipe.

575—*Q.—What must be done to insure that the anchor ring will have full supporting bearing on the pipe?* A.—The thread must be straight, that is, cut substantially parallel with the axis of the pipe, which will automatically occur if the pipe threading tools are in good condition.

576—*Q.—How must the pipe be so formed and Fitted?* A.—So that when it is in place, the face of the flanged fitting, with the gasket removed, will contact squarely with the surface to which it will be clamped and that the bolt holes are in line to permit application of the cap screws without springing the pipe. The gasket can then be applied and the fitting clamped in place with the cap-screw bolts which should be solidly tightened.

577—*Q.—What is the proper method of installing a control valve on a car?* A.—The bracket should be installed as near the brake pipe as possible so that the branch pipe may be short; short bends in the piping should be avoided also. Care should be taken in locating the valve to have it free from obstructions which would render inspection or removal difficult. The control valve should be placed above the general level of the piping and the piping so arranged as to avoid pockets in which moisture may collect.

578—*Q.—What may happen if this point does not receive proper attention?* A.—Trouble may be experienced in cold weather from the freezing of water in the pipes or in the valve.

579—*Q.—What precautions should be taken in respect to the installation of piping used with the control-valve equipment?* A.—Before installing the control valve, all of the piping should be thoroughly hammered and blown out, in order to loosen and remove all scale or foreign matter. A suitable compound to make a tight joint should be applied on the male threaded portion only, and never in the socket. Do not use red or white lead. After the piping is complete, all joints should be thoroughly tested under pressure with soapsuds and made air-tight.

580—*Q.—When necessary to clean and lubricate the control valve, should this be done at the car?* A.—Never remove the operating parts of the control valve at the car. If one of the portions of the valve is not working properly, or needs cleaning and lubricating, take it down and replace by a portion in good condition. All cleaning and lubricating should be done at a bench, by a competent man, where the liability of damage to the internal parts is least. Any attempt to remove the moving parts of the valve while still on the car is almost sure to result in a large percentage of valves being injured by careless handling or dirt getting inside the pipes or valves.

581—*Q.—How should the service portion be cleaned and lubricated?* A.—The piston, slide valve, and graduating valve and bushings must be thoroughly cleaned so as to remove all dirt, oil, gum or grease. Benzine, gasoline or other approved cleaning fluid can be used for this purpose. The packing ring and its groove should be cleaned without removing the ring from the piston groove. This can be done by dipping the piston in the cleaning fluid and then moving the ring around the groove. This operation should be repeated until the groove and ring are thoroughly cleaned, after which the excess cleaning fluid can be blown away or dried by using an air jet. Where rings are stuck with dirt too tightly to be moved in the groove, it may be necessary to soak the ring in penetrating oil and then tap the ring lightly with a hard wood block. For this purpose, a maple or hickory wooden block about 1 in. by 1 in. by 4 in. (with square ends) should be used to tap the ring so as to drive it flush with the top edge of the groove.

582—*Q.—How should this tapping be done?* A.—This tapping should start at one side of the ring joint and progress around the piston in short steps until the ring is loosened sufficiently to be moved in the groove.

583—*Q.—If this procedure will not loosen the ring, what must be done?* A.—It is evidence that the groove must be reconditioned and a new ring fitted.

584—*Q.—How must the slide and graduating valves be lubricated?* A.—The face of the graduating valve, the upper surface of the slide valve (which is the graduating valve seat), the slide valve seat, and the upper portion of the bushing (slide valve spring bearing), must be glazed with the best grade of very fine, pure, dry, air-brake graphite applied with a paddle made of wood about 8 in. long having a small piece of chamois skin glued to the paddle end. There must be no free graphite allowed to remain on the valves or seats and they must be free from any oil or grease before the graphite is applied.

A New Atlas Journal Jack

A light and compact Atlas journal jack, recently developed by the Railroad Division of the Portable Plating & Equipment Co., Chicago, weighs complete with 25-ton hydraulic unit, only 62 lb. Changing brasses with this jack is said to be usually completed in two to four minutes—less time than is required to get most other types of equipment into position. Changing or inspecting brasses, regardless of weather conditions, therefore becomes a simple routine.

The Atlas journal-jack equipment consists of three units: (1) A strong steel arm or hook which attaches securely to the top of the car wheel, (2) an oversize cable as an integral part of the adjustment ladder and a platform or stirrup for the jack unit, (3) and the small but powerful Atlas 25-ton hydraulic jack. All three units combine to promote safe, fast and dependable brass changing and inspection. The Atlas journal jack requires no heavy cumbersome blocks or wheel hold-down plates. There can be no wheel movement, as the entire suspended weight is transferred directly to the wheel. The adjustment ladder readily adapts the equipment to journal boxes of various sizes.

Atlas 25-ton hydraulic journal jack as used in inspecting and servicing a freight-car journal and changing the brass if necessary

As the lifting pressure on the journal box reacts directly to hold the wheel down (see illustration) it will be apparent that bearings can be safely and easily inspected or a brass immediately replaced on any track. The train crew or car inspectors do not need to carry special blocking or fittings. Ice, snow, mud, soft ground, or decayed ties offer no handicap, as the use of this jack is independent of the roadbed condition.

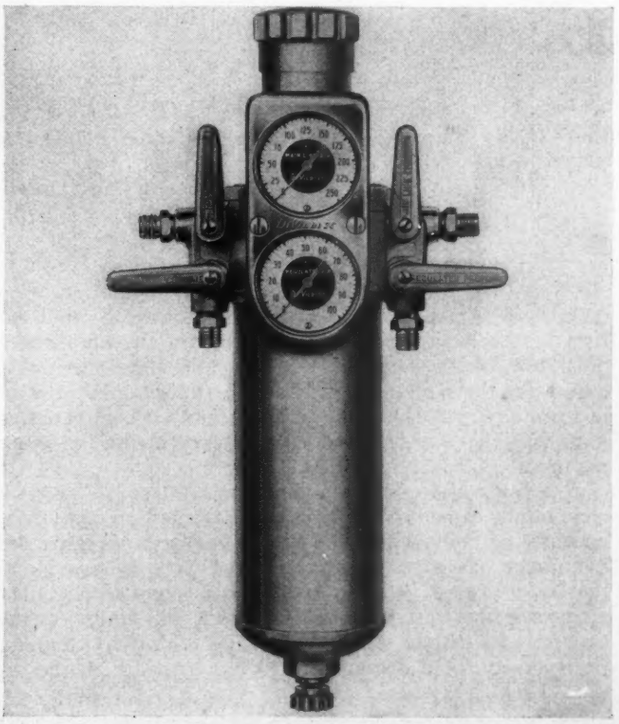
One of the most important advantages of this type of jack is that it helps keep special freight moving. It readily facilitates the servicing of a hot box, thus avoiding serious delays and frequently avoiding the necessity of cutting out cars enroute. Perishable freight is kept moving, at a great saving to the carrier and substantial benefits from improved shipper relations.

The Atlas journal jack is safe, portable, and strictly a one-man journal-bearing remover. As a separate unit, the jack is adaptable to general railroad maintenance work. It has a lifting power of 50,000 lb., light weight of 27 lb., and small size, 6½ in. high. It is convenient for changing locomotive spring hangers and tender-truck bearings, spring planks on passenger coaches and for use under the side-frame members of freight-car trucks, in this instance enabling both journal wedges and both brasses to be quickly removed in one operation.

Air Transformer for Spray-Painting Process

A new air transformer, known as the Type HLC, has been developed by the DeVilbiss Company, Toledo, Ohio. This equipment is for use in the spray-painting process to furnish the spray gun with clean, moisture-free air. It handles in excess of 50 cu. ft. of air per minute. The transformer will pass an ample supply of air for two spray guns in continuous and simultaneous operation or for three spray guns in ordinary, intermittent production use.

This equipment has a synthetic-rubber regulator diaphragm and a big regulator knob conveniently located. A large condensing chamber allows for greater air expansion and more thorough condensation of moisture. The air is cleansed effectively by an improved baffle arrangement. The new metal filter, wholly mechanical, eliminates the cotton waste pack and the necessity for its repeated removal and replacement. The enclosed pressure gages and the die-cast body complete the streamline style of the transformer. The cylinder is chromium plated and highly polished to prevent the accumulation of dirt, dust, or paint so that the exterior of the equipment may be easily kept clean.



The DeVilbiss Type HLC air transformer furnishes clean, moisture-free air to the spray gun

The Reinforcement of Defective Boiler Shells*

By E. H. Heidel

One of the problems confronting the boiler foreman is to decide what type of repairs to make to the boiler shells of the older and smaller locomotives still in use in considerable numbers on branch lines and secondary divisions. These boilers are from 25 to 30 years old, carry in the neighborhood of 200 lb. per sq. in. pressure, and have been superheated in most cases. Often these boilers are on locomotives which have been converted from compound to single-expansion engines with new frames and relocated waist-sheet angle irons, pump bracket, braces, etc. Abandoned stud holes, which have been plugged, are often found in many locations. These boilers are, of

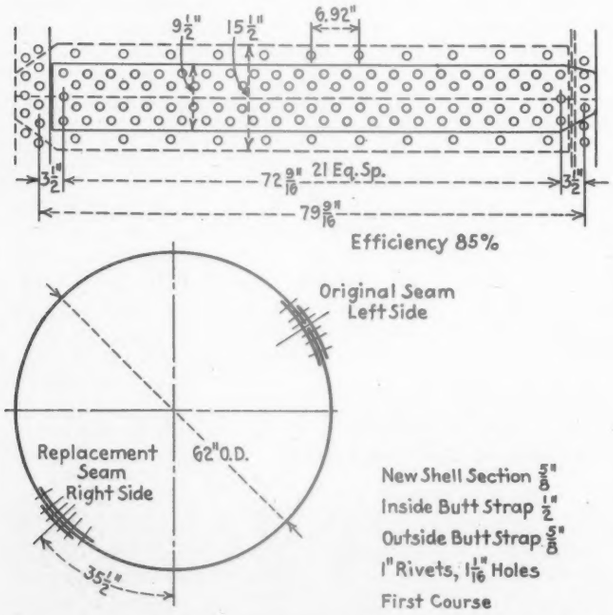


Fig. 1—A new bottom was applied to the first course of the boiler

course, required to have the same factor of safety as the boilers of new locomotives, and the boiler foreman is required to repair the boiler in the most economical manner consistent with good boiler practice.

The pitting and grooving of the shell courses of these older boilers is a case in point. The age and general design of the locomotive does not warrant the application of a new boiler shell, or even a single course in many cases, but the boiler must be put in proper shape for an indefinite period. During the past month a boiler of this kind was encountered, and was handled in the following manner.

A ten-wheel locomotive, built in 1900 as a Vauclain compound, came to the shop for classified repairs from an outlying point where the engine had been working for a number of years. After the flues were removed and the boiler scaled, the first course was found to be pitted along a strip 15 in. wide extending the full length of the course, and in one section about 10 in. wide extending transversely for a distance of 40 in. In addition, the in-

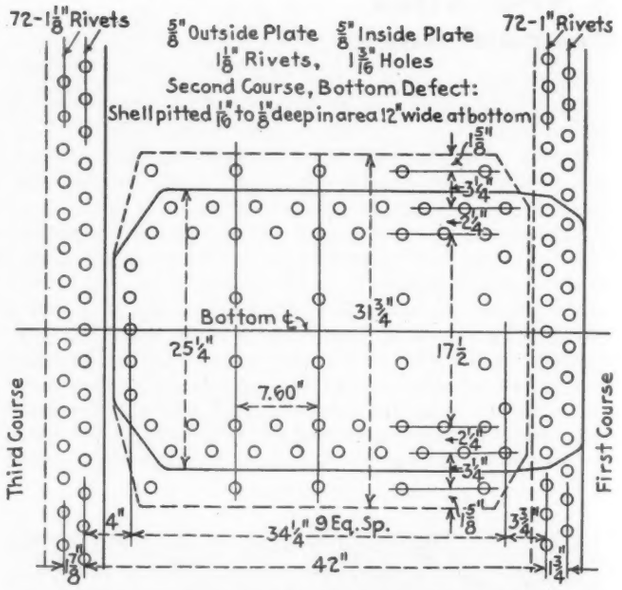


Fig. 2—The second course of the boiler was repaired by the application of wide inside and outside straps along the bottom center line

terior of the shell, directly below the left boiler check, was defective and required patching. The defective portion of this course covered a large area and made any local reinforcement unsatisfactory. It was consequently decided to apply a new bottom to the course, duplicating the original seam on the opposite side of the boiler, as shown in Fig. 1. No change in stresses was caused by

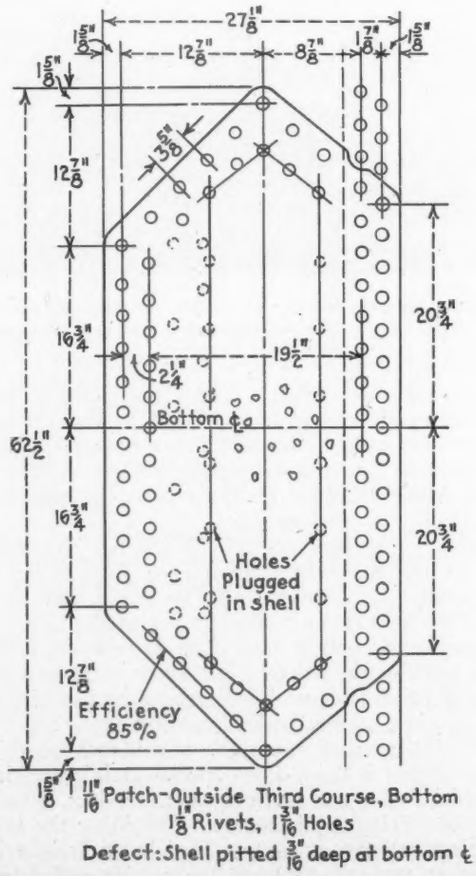


Fig. 3—The third course of the boiler was reinforced by a patch on the outside of the shell

* An entry in the prize competition on boiler patches, announced in the March, 1939, issue. The names of the winners were published in the August, 1939, issue. The author is general boiler foreman, Milwaukee locomotive shops, Chicago, Milwaukee, St. Paul and Pacific, Milwaukee, Wisconsin.

this repair, and the first course was restored to its original strength.

The second course of the boiler was tapered and rather short, and the shell was in good shape generally, except for scattered pits and some grooving at the back edge of the first course. The condition of this course did not warrant very extensive repairs, but could not be disregarded entirely. Repairs were made by applying wide inside and outside butt straps along the bottom center line of the boiler, as shown on Fig. 2. This reinforced the defective portion of the shell in a simple manner without increasing the shearing stress on rivets or the tension in the net section of the plate.

The third course sheet was badly pitted in an area about 20 in. in diameter along the bottom center line directly back of the second-course girth seam, and this condition was complicated by the presence of a number of abandoned stud holes which had been plugged at the time the engine was converted to single expansion. The rear portion of this shell course and the back flue-sheet braces, however, were in good condition, and it was not desirable to disturb these braces. The defective portion of this course was reinforced by applying a patch on the outside of the shell, taking in the entire defective portion of the sheet, and replacing the existing wear plate for the back waist-sheet angles. By making the plate efficiency of the diagonal seam equal to that of the longitudinal seam, the tension in the net section of plate was not increased. This repair is shown in Fig. 3.

Thus the entire boiler shell was returned to its proper strength in a simple and inexpensive manner, each course being treated as a separate problem, and repaired in a different way. While this boiler presented no particularly difficult or unusual condition, it is offered as an economical and satisfactory solution to a common problem confronting the boiler foreman.

Reconditioning Carbon-Steel Springs

The equipment and methods employed at the Point St. Charles locomotive shops of the Canadian National to repair locomotive, tender, and coach springs has resulted in the production of springs of uniform quality and with a much greater service life than was obtained from springs made by former methods. The accurate control of the temperatures in the heat treatment of carbon-steel springs is furnished by electric furnaces and auxiliary equipment. Instead of attempting to heat treat the spring leaves immediately after forming them, the forming and heat treatment have been separated into two distinct operations. Also, a close check is made by test equipment to insure that each spring has the characteristics required by the specifications.

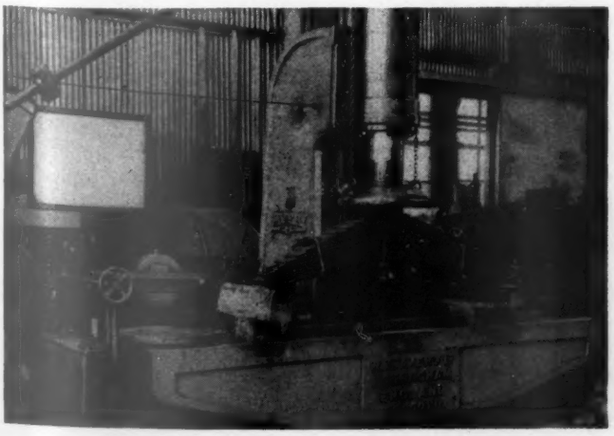
Spring forming machine and electric furnaces used in heating

The springs are first placed in the testing machine as shown in one of the illustrations and are checked for free height and deflections under load. If the springs meet the test requirements and have no defects, they are placed in a No-Ox-Id bath. This solution is at a temperature of 175 deg. F. and is both a rust preventative and a lubricant. Springs which do not meet the specifications are taken to the stripping machine where the spring bands are removed.

Electric furnace with control equipment and oil vat for heat treatment of the springs

The spring leaves that are broken or worn are removed and replaced by new leaves. All the leaves of the entire spring are then placed in an electric furnace and are brought to a temperature of 1,600 deg. F. After heating, the leaves are reset on a spring-forming machine. To produce the proper camber and to insure that all springs are made uniform, a leaf from a master spring is inserted in the bending machine with each corresponding leaf of the spring being reconditioned.

The leaves are not heat treated directly after they are removed from the forming machine. They are allowed



The springs are checked in this testing machine

to cool, after which they are placed in another electric furnace where they are heated to 1,550 deg. F. and then quenched in oil. The furnace temperature is controlled and recorded by an electric pyrometer. After quenching, the leaves are washed in a caustic solution to remove the oil. The next operation is to place the leaves in a third electric furnace in which they are heated to 725 deg. F.; they are then air cooled.

This operation completes the heat treatment of the springs and, as all the leaves of each spring have received the same treatment in each successive operation, the uniformity of the springs is insured. For this reason, only one leaf from each heat is tested in a Brinell testing machine and checked for the required hardness of 387 Brinell.

The spring leaves are sent next to the spring-banding machine where the bands are applied. Here too, the bands are heated in an electric furnace. The spring is next marked for identification with the proper letter symbols and the date. The completed spring is placed in the No-Ox-Id bath and from here it is again taken to the testing machine where it must meet the specifications for that particular spring.

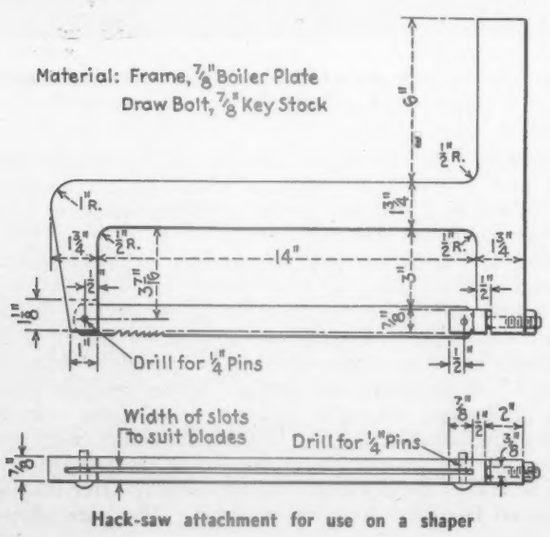
Slotting Rod Bushings On a Shaper

Slotting locomotive rod bushings may be done quickly and economically on a shaper with the hack-saw attachment shown in the illustration. This device is being used to advantage on a southwestern railroad, resulting in a saving of time over other methods and relieving milling machines for more important work.

The conventional power hack saw found in most shops is not suitable for this work because of the limited stroke adjustment and the fact that the design of the vise for holding the work is not adapted to this particular job.

The attachment replaces the ordinary tool in the shaper and is fastened in the usual way except that it must be set accurately vertical. The work is held in the vise or by other suitable means and the saw fed into the work by hand. The stroke is set to the maximum commensurate with the length of the work. High-speed-steel blades with a coarse pitch produce the best result.

The device is a practical shaper accessory and may be used in connection with other operations on the shaper which will suggest themselves to the man in the shop.

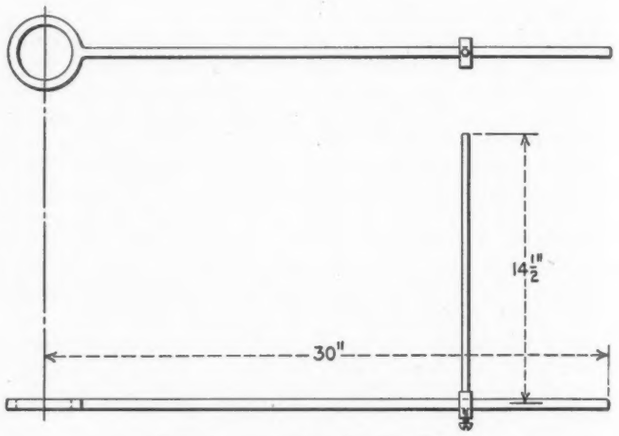


Hack-saw attachment for use on a shaper

Gaging the Length Of Locomotive Drawbars

By A. D. Hollis

The simple gage shown in the drawing is not as widely used as its usefulness would justify. To check the length of a locomotive drawbar before it is applied, or to tell the blacksmith shop foreman the length to which it should be adjusted, a dummy wooden pin the same



Gage for measuring drawbar lengths

size as the usual draw-bar pin is used through the round hole in the end of the gage. It is placed in the position the drawbar will occupy first on the tank and then on the locomotive, or vice versa, with the buffer and its wedge in the desired position. It is held level with the short arm contacting the buffer surface. After adjusting the short arm to suit, this length is measured with a rule and noted. One measurement is obtained for the locomotive and another for the tank and the sum of these two dimensions will be the proper drawbar length. If this gage is used it will seldom be necessary to remove a heavy drawbar and change the length after attempting to couple a locomotive and tender together.

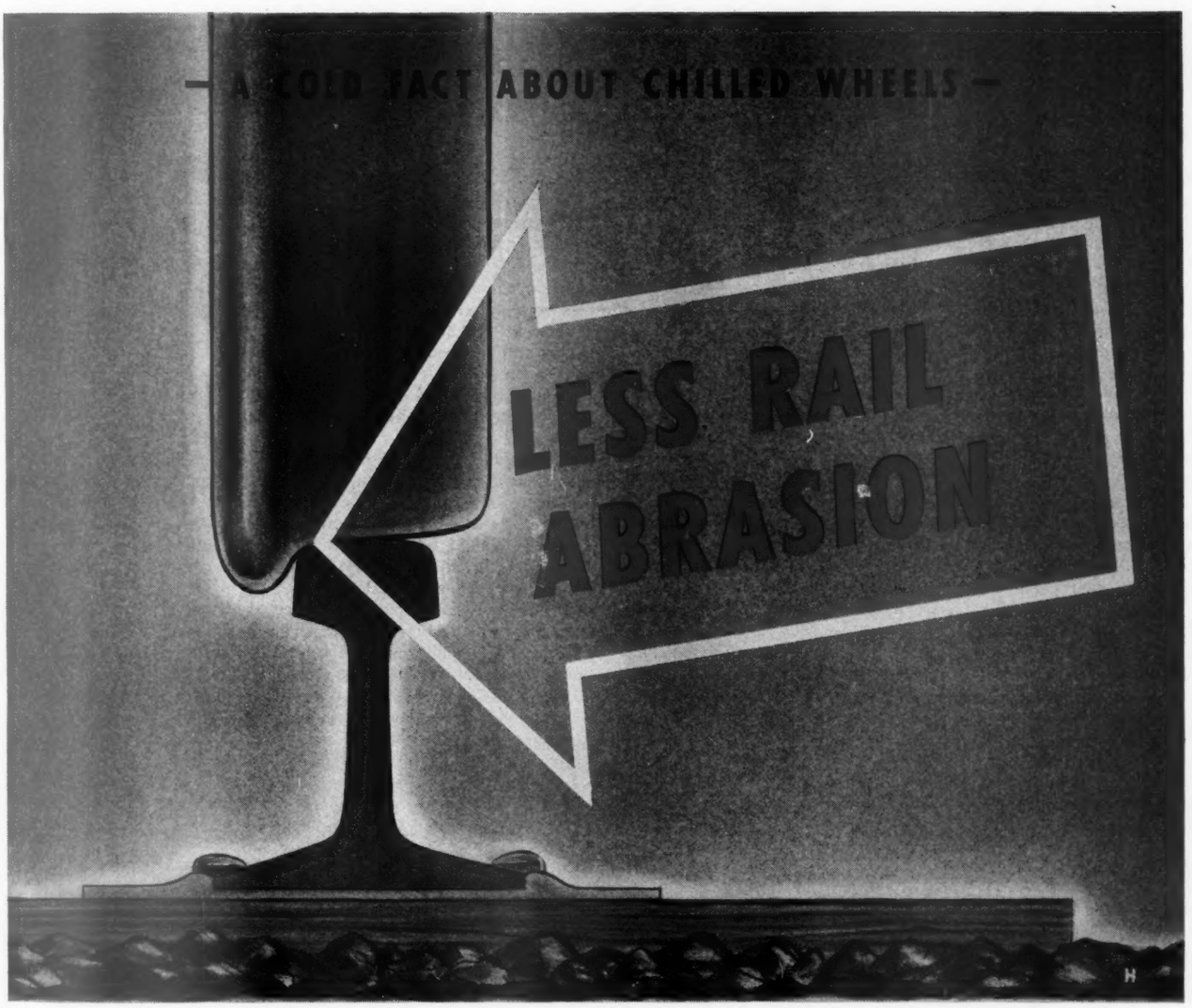
Instructions for Maintaining Diesel-Electric Equipment

In the April issue of *Railway Mechanical Engineer*, there appeared on page 131, an abstract of a paper by H. V. Gill, supervisor of Diesel locomotives, Atchison, Topeka & Santa Fe, on the design, operation and maintenance of Diesel-electric locomotives. In that paper mention was made of a special instruction bulletin covering the inspection and maintenance of road and switching locomotives as reported on Forms 1226-D and 1226-DS appearing on pages 133 and 134. These instructions are reprinted here for the benefit of our readers.

Diesel Engines

Crankcases—Diesel engine crankcases should be examined carefully for loose or broken main bearing studs or bolts; loose-bearing caps; loose main bearing lower supports; loose main bearing jacks; cracks in engine frame or in bearing supports; broken or loose oil lines, or oil distribution manifolds; missing lock wires or cotter keys. Observe closely the condition of the lower part of the cylinder liners and pistons for cracks, scored condition and pieces broken out.

(*Continued on next left-hand page*)



The low coefficient of rail abrasion of chilled iron wheels not only reduces wear of rails but, materially decreases train resistance and makes another important contribution to economy of operation.

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❶ **Increased rail life.** ❷ **Reduced machine shop costs.**

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Connecting rods should be examined for loose bolts or studs; loose bearings in the connecting rod; missing cotter keys; excessive bearing wear as indicated by the lowering of the connecting rod. Any indication of bent condition or misalignment of rod should be corrected. No chances should be taken with crankshafts, or crankshaft bearings or bearing supports as serious damage to the engine will be the result.

Any indication of bearing metals that have pounded out, or flaked out, or where fine particles of bearing metal has been thrown out into the crankcase must be investigated carefully. The defective bearing should be located and removed.

During crankcase inspection attention should be given to any gaskets, or other conditions that would be causing, or cause lubricating oil to leak from parts of the engine. Also note if water or air is leaking into the crankcase by seal rings or cylinder liners.

Any unusual noise in the blowers, gear trains or timing chains should be investigated and repaired.

Injection Timing—The timing of the fuel pumps or fuel injectors should be carefully checked to be sure the injectors are properly set to start the injection of the fuel charge at the proper time according to instructions covering the type of engine used.

Injection Control Linkage—Injection control linkage should be properly adjusted so that all injector racks will be opened and closed uniformly and that no cylinders will have excessive rack travel in full-load position. Consult instructions for details covering each particular type of Diesel engine.

Cylinder Head Valve Lash Adjusters or Valve Clearances—Engines using automatic exhaust valve lash adjusters should have these checked for proper contact with the valve stem cap and to make sure that the cams are in the proper position.

Engines using valve clearance, on exhaust and intake valves, should have these checked to be sure the clearance conforms with the instructions for each particular type of engine.

While cylinder head covers are off for valve clearance check the rocker arm assembly, and all other parts under the cover should be examined for good condition. Any leaky gaskets, or fuel leaks, should be repaired and reported.

Cylinder Heads for Leaky Valve—Test of cylinder heads for leaky valves may be made with the engine running at slow speed. Any valves found worn, sticking or blowing should be removed and the condition corrected.

V-Belt Drives—All V-belt drives should be inspected for loose pulleys, worn grooves in the pulley, loose or defective belts, loose or worn flexible couplings. V belts drive the most important auxiliaries to the power plant, such as air compressor, traction-motor blower, cooling fans, boiler-water pumps and blower. Any defective condition should be corrected.

Flush Engine Cooling System—Flushing of the engine cooling system may be done by circulating a recommended chemical solution for the proper length of time, or by using clear water. When chemicals are used proper record should be made on a form stating the chemical used and if water treatment is used this should also be recorded. Special instructions covering the kind of chemical used should be closely followed. (No chemicals or water treatment should be used unless approved).

Fuel System Piping—Fuel tank and connecting piping must be carefully examined for loose pipes that may chafe against other parts of the locomotive, pipes not properly clamped, leaky or not properly secured fuel tank and leaky pipe joints. Any condition that would create a fire hazard should be corrected at once.

Safety Cut-Off Valve on Fuel System—The safety cut-off valve in the fuel system should be tested to be sure it properly cuts off the flow of fuel. This should be handled by breaking a pipe joint in the line of discharge side of the fuel pump and not by tripping the cut-off valve, thus allowing the engine to starve for fuel. The injector plungers are a very close fit in the barrels and depend upon the fuel for lubrication. If the fuel supply is shut off, scoring and seizing of the injectors will result.

Fuel Pumps—Fuel pumps should be checked for leaky condition, tight on base, condition of drive. There should be no binding of the motor or fuel pump but it should turn freely. The pump may be checked for capacity by noting gage pressure and noting the amount of excess fuel being returned to fuel tanks.

Piston Inspection—Pistons should be inspected through the air-box openings or through the crankcases for scored skirts, burned heads, stuck rings, broken rings or correct ring tension, excessive gap openings in rings indicating wear, water leaks in cylinder, proper lubrication of cylinder walls and any indication of defective condition should be corrected before the Diesel engine is returned to service.

Lubricating Oil System—The lubricating oil system should be maintained in first-class condition, free from all leaks. Check carefully for leaky joints and improperly secured pipes. If low pressure is indicated on the gage, a thorough investigation should be made and loss of pressure corrected. Otherwise expensive damage may be done to the engine.

Drain Sediment From Fuel Tanks—Each tank is equipped with a sump which has a drain plug in the bottom. This drain plug has a stop on it that prevents its being completely removed. The vent of the drain plug has a drain hole through which water and sediment is drained from the fuel tank. Careful attention should be given to the operation to keep the water and sediment drain out of the fuel tanks as both will damage the fuel injectors and may result in complete failure of the Diesel engine.

Inspection of Timing Chains or Timing Gears—Where silent chains are used they should be inspected for cracked side bars, broken rollers, proper tension—chain may be too loose or too tight. If found loose or tight, the automatic slack takeup assembly should be inspected for proper operation. Chains may be inspected through inspection openings in the housing by baring the engine over slowly.

The timing gears may be inspected through inspection openings for broken teeth or excessive wear of the teeth.

Any noisy condition of the timing chains, or timing gears, should be investigated to prevent damage.

Check Injectors for Tightness—Individual injector assemblies or injection fuel pump assemblies should be inspected for tightness in cylinder heads and for loose or defective condition of mounting brackets. Where drive shafts and couplings are used on Bosch system these should be included in the above inspections. High-pressure fuel lines must be given special attention.

Water Pumps—Water pumps should be examined for loose impellers, worn bearings, corroded impellers, leaky conditions at water seals or packing glands. Any condition that has been reported on the water system should be thoroughly investigated. The first item to be checked should be the water pump to be sure the pump is properly circulating water through the system.

Main Governor—Woodward hydraulic governors are used on Diesel engines for speed control and it is imperative that these devices be kept very clean. The same oil as used in the crankcase of the Diesel engine is used in the governors. Governor oil seals should be renewed when leaking and the governor flushed out or adjusted or repaired whenever reported as operating improperly.

The following practice should be followed when flushing out the governor: drain out the oil; fill with clean fuel oil; open both surge control valves; run the engine at idle speed for one minute; stop the engine and drain out the fuel oil; fill with clean, new oil and run the engine at a little above idling speed for one minute; drain out the oil and apply fresh, clean oil; start the engine and adjust the governor surge control valve.

If necessary to dismantle the governor, this operation should be handled by a competent repairman only after a thorough study of the instruction manual has been made. Extreme care must be taken to have all parts perfectly clean before the governor is reassembled.

Overspeed Governors—The overspeed governors must be kept clean and repaired whenever reported as erratic in operation. Where Woodward type governor is used, the same oil as used in the Diesel engine crankcase should be used. When the main engine governor is flushed out or cleaned the overspeed governor should also be cleaned.

Cooling Radiators and Connecting Piping—Radiators and connecting piping should be inspected for leaks, defective hose connections, accumulation of dirt in between or around the radiator tubes or fires. If loss of radiator water has been noted, or reported, and no leaks are found, it will be necessary to check the engine cylinders for defective gaskets or cracked cylinder liners or cracked cylinder head.

If oil is found in the cooling water system, it will be necessary

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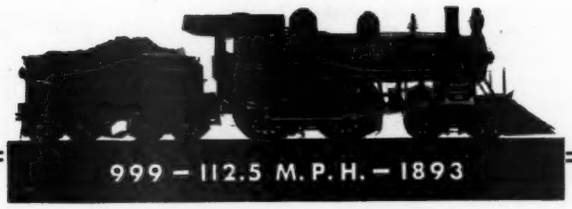
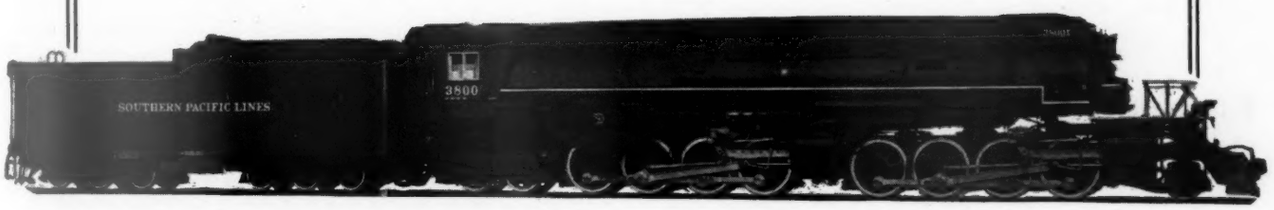


They're both fast...



. . . BUT IT TAKES "MODERN POWER" TO HAUL TODAY'S LOADS PROFITABLY

Old "999" was fast, but today's traffic demands call for high hauling capacity as well as high speed. That is why railroads are ordering "Modern Power."

The above photograph illustrates an example of "Modern Power" designed for high-speed freight and passenger service in mountainous territory.

LIMA LOCOMOTIVE WORKS LIMA LOCOMOTIVE WORKS INCORPORATED **INCORPORATED, LIMA, OHIO**

to locate the source of the oil leak and correct the condition. Oil leak into cooling water will generally be from the oil cooler.

Blow Out All Radiators—Radiators may be blown out using clean, dry air. On engines with radiators mounted in a well, attention should also be given to keep dirt, cinders, etc., from accumulating and building up around the radiator.

Inspect Coupling Between Diesel Engines and Generators—Flexible coupling which connects the Diesel engines to the generator should be carefully inspected for loose or broken drive studs, broken discs, noisy operation or coupling which indicates misalignment. Any indication or defective condition should be investigated and corrected.

Main Crankshaft Bearings—Should be removed and examined at the time of the annual inspection on switching locomotives. The main crankshaft bearings should be examined on passenger road locomotives every 100,000 miles of service. The three center main bearings should be removed and closely inspected, and if found in good condition, the balance of the bearings may be continued in service without removing them. If the center main or adjacent bearings are found in bad condition, all bearings should be removed. At the end of 300,000 miles of service, all main bearings should be renewed for inspection on road locomotives.

Connecting Rod Bearings, Crankshaft End—Should be closely inspected when the pistons are removed, special attention should be given to the upper half of the connecting rod bearing in two-cycle engines. Any bearing that shows indications of pitting, flaking, cracking, or indications of bearing shell coming in contact with the journal must be renewed to avoid damage to the crankshaft.

[NOTE—Additional sections of the instruction bulletin cover electrical equipment, lubrication and cleaning. These will appear in later issues—Editor.]

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

The Application of Front Tube Sheets by Welding

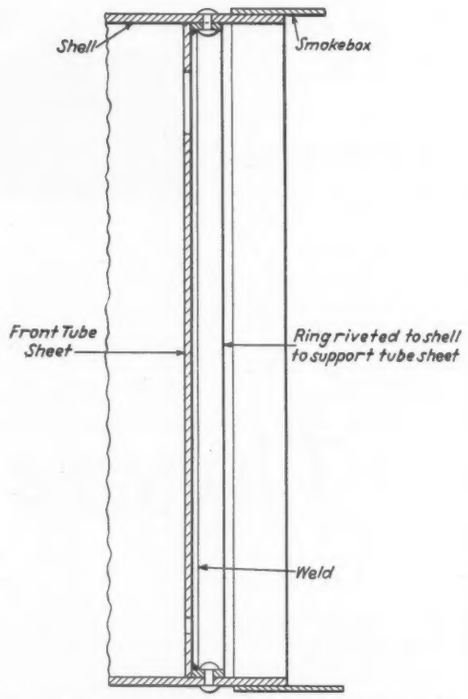
Q.—We are having considerable trouble with the knuckles of our front tube sheets cracking and have been advised to weld the tube sheets into the shell, omitting the flange. Is this being done?—H. G. D.

A.—There are several methods of applying front tube sheets by welding and thus eliminating the flanged knuckle, but in no case is the tube sheet welded to the shell of the boiler.

The illustration shows a method of applying a front tube sheet by welding which can be applied to new work or repairs. It consists of a ring riveted to the inside of the shell, with the front tube sheet set inside of the ring and welded to the ring from the smokebox side.

For repairs the present flange on the tube sheet should be allowed to remain in the boiler by burning out the old tube sheet at the knuckle. The remaining flange or ring should then be chipped smooth for the application of the new tube sheet.

The new tube sheet is passed into the boiler by notching out the ring at each side on the center line of the boiler a sufficient amount to allow the new tube sheet to pass through.



A method of applying the front tube sheet by welding

Reinforcing a Circumferential Groove in a Boiler Shell

Q.—Will you be good enough to give me what you consider an efficient method of patching a circumferential groove 3/8 in. deep by 1 in. wide by 30 in. long in a shell having a plate thickness of 9/16 in.? An example of this type of grooving was shown on page 238, August, 1930, issue of the "Boiler Maker."—E.A.B.

A.—The ends of the patch should be designed as a half diagonal patch. The spacing of the outside row of rivets should be determined from the formula:

$$E = \frac{2\ (P - d)}{P\ \sqrt{3\ \text{sine}\ B + 1}}$$

where

E = efficiency, per cent.
P = pitch of rivets in outside row, in.
d = diameter of rivet hole, in.
B = angle of outside row of rivets as illustrated, deg.

The thickness of the patch should be the same as the

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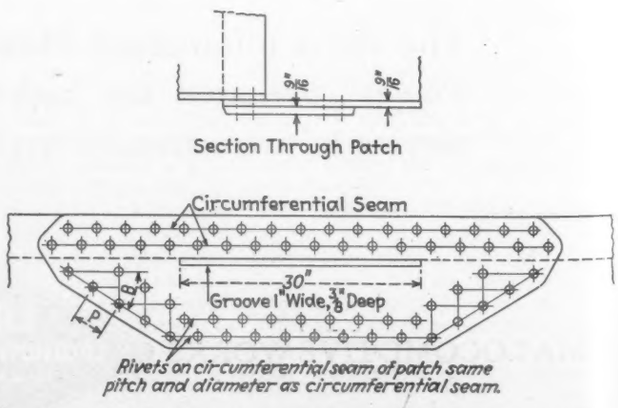

Section Through Patch
Circumferential Seam
30"
Groove 1" Wide, 3/8" Deep
Rivets on circumferential seam of patch same pitch and diameter as circumferential seam.

A method of patching a circumferential groove in a boiler shell

97.7%

of the steam locomotives purchased in 1939

HAVE

FRANKLIN E-2 RADIAL BUFFERS

97.7% of the steam locomotives purchased during 1939 for use in the United States are assured of easier riding and greater safety. Slack between engine and tender is eliminated by the application of the Franklin E-2 Radial Buffer, thus absolutely removing one of the principal causes of hard riding. » » » The Franklin E-2 Radial Buffer quickly pays for itself . . . in economy . . . in safety . . . in increased passenger comfort . . . and in lower maintenance.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

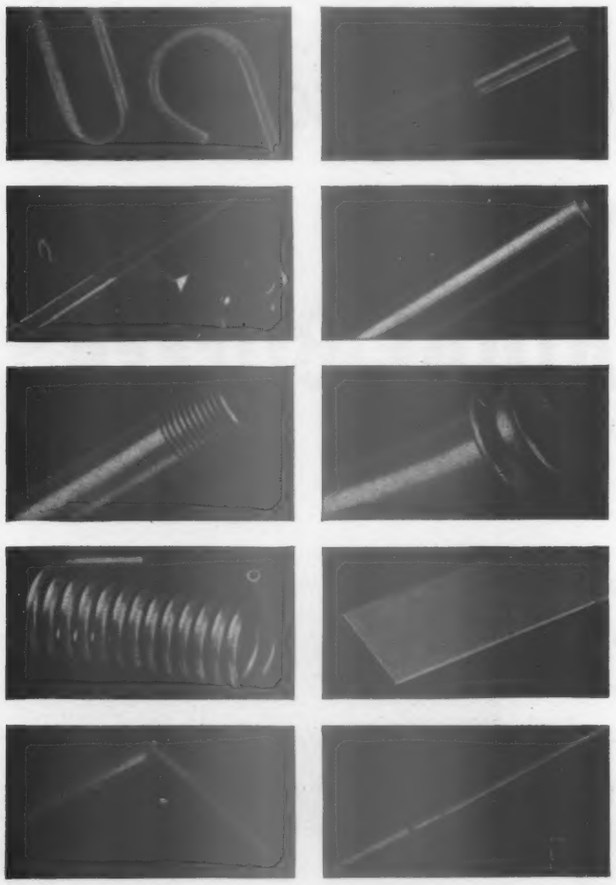
NEW YORK CHICAGO MONTREAL

thickness of the shell course to which it is attached. The size of the patch will be determined by the design of the ends of the patch required to give the proper efficiency.

Tubing of Carbon and Alloy Steel

The development of Agalloyed steel tubing, said to be comparable in quality and appearance to cold-drawn seamless tubing, has been announced by the AGA Metal Tube Company, Elizabeth, N. J. The tubing is produced by joining spirally wound cold-rolled steel strip in the hydrogen atmosphere of a high-frequency induction furnace.

The tubing can be made in all straight carbon steels as well as in chrome vanadium, chrome nickel, and



Agalloyed steel tubing can be bent, coiled, expanded, flared, flanged, swaged, spun, machined, or welded

chrome molybdenum steels. The sizes manufactured at present range from ⅛-in. to ⅝-in. outside diameter with wall thicknesses ranging from .010 to .042 in. It is claimed that the tubing has a very uniform wall thickness as it is manufactured from cold-rolled strip steel, and the close strip-steel tolerances are maintained in the finished tubing. The tubing is available in various tempers to meet particular requirements. It is furnished cold drawn and can be bent, coiled, expanded, flared, swaged, spun, machined, or welded as shown in the illustration. It will stand severe forming and with but little preparation, the surface is ideal for plating.

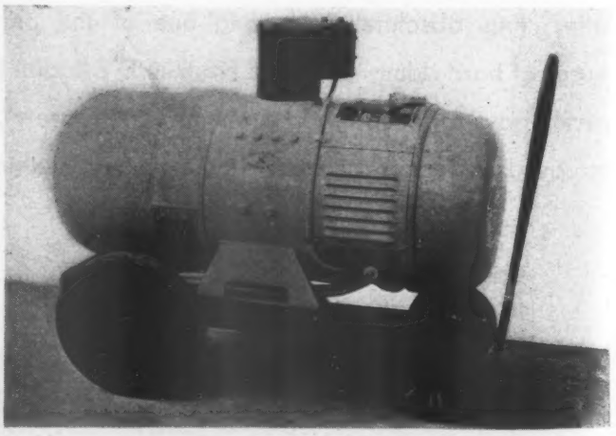
The average physical properties of annealed tubing produced from S. A. E. 1010 low-carbon-steel strip are as follows: Yield point, 27,000 to 30,000 lb. per sq. in.; tensile strength, 47,000 to 50,000 lb. per sq. in.; elongation, 38 to 42 per cent in 2 in., and reduction of area, 60 to 68 per cent. Hard-drawn tubing made from the same steel will have a tensile strength of 80,000 to 85,000 lb. per sq. in. It is possible in high-carbon and alloy-steel tubing to obtain tensile strengths in excess of 200,000 lb. per sq. in. by heat treating in a conventional manner. The tensile strength of the tubing, in any case, is always the same as the parent metal from which the tubing is made.

Remote Control for Arc Welders

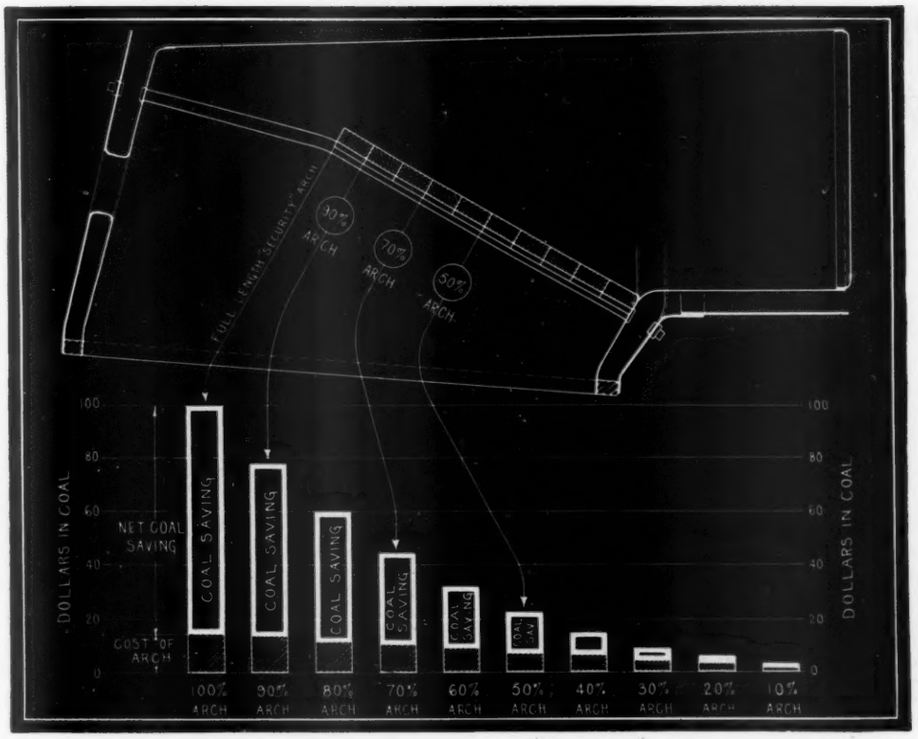
A new device for the remote control of arc welders has been announced by the Wilson Welder and Metals Company, Inc., New York. The single control of the Hornet and other Wilson arc welders is well adapted to operation by this method. To utilize this control, the handwheel which governs the control pole of the standard welder is simply replaced by the reversible motor-driven Type SC remote-control device.

It is said to cover the entire range of the machine to which it is attached in both high and low settings. The device allows minute adjustments in the current output to be made by merely touching one of two contacts on the electrode holder to the ground. When the electrode-holder button marked "more" is brought into contact with the ground, the electric motor in the remote control housing on top of the machine revolves and raises the control-pole core, increasing the output. The motor revolves only while the actual contact is maintained. When the button marked "less" is grounded, the remote control motor revolves in the opposite direction and lowers the control-pole core, decreasing the output. The contact points are shaped differently so the operator can easily locate the correct one even with poor illumination.

The 1/80-hp. electric motor, which is all that is required to operate the control pole, is protected by two limit switches and by a slip clutch to prevent damage when the end of the range is reached. The generator may be preset by push buttons mounted on the control itself.



The Wilson "Hornet" arc-welding generator equipped with the Type SC remote control for adjusting current output



THE EFFECT OF ABBREVIATED ARCHES ON FUEL SAVING

LET THE ARCH HELP YOU SAVE

With the emphasis being placed on saving every railroad dollar, the locomotive Arch becomes increasingly important.

Regardless of the amount of traffic handled, the locomotive Arch saves enough fuel to pay for itself ten times over.

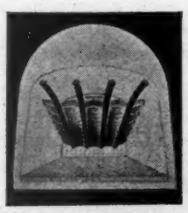
Be sure that every locomotive leaving the roundhouse has its Arch complete with not a single brick nor a single course missing.

In this way, you will get more work for each dollar of fuel expense. Skimping on Arch Brick results in a net loss to the railroad.

THERE'S MORE TO SECURITY ARCHES THAN JUST BRICK

HARBISON-WALKER REFRACTORIES CO.

Refractory Specialists



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Locomotive Combustion Specialists

High Spots in

Railway Affairs . . .

Wages Up

In the so-called boom year, 1929, the average annual compensation of the maintenance of equipment and stores employees was $1,668. Five years later, in 1934, in the heart of the depression, it had fallen to $1,341. A decade later in 1939, when business in this country was none too good and unemployment still at the high point, this average compensation had increased to $1,736. The average maintenance of equipment and stores employee, therefore, drew $68. more during 1939 than in 1929 and the dollar would purchase much more in 1939. Unfortunately, however, fewer employees were required in 1939 than in 1929 and the total wages paid was therefore less, although they were about the same percentage of the total operating revenues of the railroads as in 1929.

Low Passenger Fares For New York World's Fair

In spite of wars and rumors of war, the New York World's Fair is preparing for a still more elaborate and ambitious program for this, its second season. The Trunk Line Association railroads are making special rates for the duration of the Fair, well below those which were in effect last year. These special rates vary according to the distance, return-time limit and party-quantity. The minimum rate is .75 cents per mile for parties of 25, under the age of 18, who may make a one-day visit to and from the Fair from any point in trunk line territory. Another example of an extremely low rate is that for round-trip coach fares for parties of 300, which are based on a general one-cent per mile rate in each direction, or for parties of 500 or more, which are on a general basis of .85 cents. Still greater reductions are available for school children.

Double-Heading Forbidden

Double-heading and pushing have been common features of railway operation in every country of the world on all kinds of trains, and with every form of motive power, since the earliest days of railroading. The number of accidents definitely traceable to these practices is but an infinitesimal percentage of the number due wholly to carelessness or neglect on the part of train and engine crews. In spite of this, and possibly influenced by the approaching primary elections, the State Railroad Commission of Texas has issued an order prohibiting the use of two motive power units on one train, except under special permits allowing additional power to move trains over steep grades. The Commission held a hearing, at which representatives of the trainmen's unions testified that double-headers had caused accidents and serious injuries, although the company officials insisted that such operations were not hazardous, but were in the interests of economical operation.

Moral Rearmament

Dictators drunk with power and regardless of the welfare of humanity, are bringing dire disaster to many nations and millions of people. The whole world seems to be delicately balanced on the brink of chaos It behooves us in this favored land to examine our own attitudes and actions critically. Is not too much of this spirit of dictatorship evident in the dealings between various groups and classes in this country? The action of the Railway Labor Executives' Association in passing a resolution on "moral rearmament" is greatly to be commended. The preamble includes the statement: "It is an easy matter to lay the blame on others and to refuse to walk the straight path of personal responsibility. But the times demand an honest facing by every man and every nation of their own guilt in our common crisis." The resolution, which was unanimously adopted, reads as follows: "One of the most baffling questions before this nation today is how to break the vicious circle of bitterness that commonly enters all negotiations between groups having conflicting interests. Our greatest need is for the rise of a new spirit that will replace that bitterness with creative planning for national unity. For that change, labor has a joint responsibility with all other groups of our citizens, and we are convinced that the time has come to face it squarely on the principles of moral rearmament. Accordingly, we pledge ourselves to help labor find its place of moral leadership in American life, and set a pattern of co-operation within its own ranks."

Suggests Waterway Tolls

There has been a growing sentiment in favor of charging tolls for waterways which are maintained at public expense. Even President Roosevelt has voiced such a recommendation. Now comes Mr. Eastman's subsidy report, which includes a somewhat similar recommendation, although, it is true, he treads a bit lightly on this troublesome ground. "I would not at the start advocate in most instances," he said, "fully compensatory tolls, but only such as it is believed the traffic will be able to bear, leaving future tolls to be determined in the light of experience." It is too bad, is it not, that the same sympathetic consideration has not been extended to the railroads—the neglected orphans of transportation? Mr. Eastman does make another statement in the report with which we are in cordial agreement. "It may be conceded," he says, "that the introduction of more efficient or economical means of transportation ought not to be prevented to save existing carriers from injury, for otherwise progress would be stopped. *However, in determining whether a new means of transportation is actually more efficient or economical, plainly all the costs which are incurred in making it available must be taken into consideration, and not a part of them only.*"

(*Turn to next left hand page*)

Railroad Labor Appears Before T. N. E. C.

As was to be expected, railroad labor presented its views before Senator O'Mahoney's Temporary National Economic Committee. George M. Harrison, president of the Brotherhood of Railroad Clerks, was its spokesman. President A. F. Whitney of the Brotherhood of Railroad Trainmen is expected to appear later on. Among other things, Mr. Harrison said that railroad labor wanted to see a return to a traffic level that would sustain at least 1,600,000 jobs, or about 600,000 more than are now available. In answer to a question, he said he believed this could be done if the government ceased its policy of giving subsidies to the railroads' competitors. In his earlier testimony, however, Mr. Harrison ascribed a considerable loss of jobs to the extensive use of labor saving devices. In the discussion which followed his formal presentation he was keenly critical of the railroads in losing business to the trucks, because of an alleged lack of initiative. In his opinion a mistake had been made in continuing the use of large cars and heavy locomotives. These should be replaced by smaller and lighter cars and more frequent schedules. That his own organization had some misgivings about the future of the railroads is indicated by his statement that not one dime of his organization's funds is invested in railroad securities—an interesting point of view when one considers the claims of some of the labor leaders that railroad workers, now regarded as this country's most favored labor group, are suffering at the expense of the railroad owners, many of whom have almost literally "lost their shirts."

127 million passenger miles during 1939

The "Daylights", streamlined steam trains of the Southern Pacific, covered 127,121,322 passenger miles for the year ending June 30, 1939. This passenger traffic resulted in the "Daylights" earning $3.85 per train mile, which is believed to be the highest net passenger revenue for streamliners. « « « Fast schedules call for high sustained boiler horsepower. The 4-6-4 locomotives hauling the "Daylights" are equipped with Elesco type "E" superheaters to provide maximum boiler horsepower. Modern power deserves the best in superheater equipment . . . Elesco . . . hence the selection of the type "E" for this service.

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Among the Clubs and Associations

NEW ENGLAND RAILROAD CLUB.—Annual banquet and entertainment 6:30 p. m., May 14, Copley-Plaza Hotel, Boston, Mass.

CANADIAN RAILWAY CLUB.—Meeting 8:15 p. m., May 13, Rose Room, Windsor Hotel, Montreal, Que. Speaker: H. Eckhardt, advertising expert, Kenyon & Eckhardt, New York. Subject: "First Get 'em To Listen."

PURCHASES AND STORES DIVISION, A. A. R.—The annual meeting of the Purchases & Stores division, Association of American Railroads, will be held at the Pennsylvania hotel, New York, on June 25 and 26.

NORTHWEST CAR MEN'S ASSOCIATION.—Meeting 8 p. m., May 6, Midway Club Rooms, St. Paul, Minn. Speaker: W. E. Gleb, coach shop foreman, Northern Pacific. Subject: Air Conditioning of Passenger Cars.

RAILWAY CLUB OF PITTSBURGH.—Meeting April 25, Fort Pitt Hotel, Pittsburgh, Pa. Speaker: G. O. Wedell, manager, Pittsburgh branch, York Ice Machinery Corporation, York, Pa. Subject: Air Conditioning.

CAR FOREMEN'S ASSOCIATION OF OMAHA, COUNCIL BLUFFS AND SOUTH OMAHA INTERCHANGE.—Meeting 1:30 p. m., May 9, general car foreman's office, Union Pacific, Council Bluffs, Iowa. Election of officers.

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—Regular meeting 8 p. m. May 21, Hotel DeSoto, St. Louis, Mo. Speaker: Noreus H. Roy, director of research, Waugh Equipment Company. Subject: The Draft Gear of Today—and Tomorrow. Twenty-minute motion picture, "Tomorrow's Railroads," with sound. Get-together dinner at 6:30 p. m. Morning meetings will also be held at the Broadview Hotel, and at the E. St. Louis, Mo. Lion's Club of E. St. Louis, followed by a luncheon at 12 o'clock.

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

AIR BRAKE ASSOCIATION.—R. P. Ives, Westinghouse Air Brake Company, 3400 Empire State building, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—J. F. Gettrust, P. O. Box 5522, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—C. E. Davies, 29 West Thirty-ninth street, New York.

RAILROAD DIVISION.—C. L. Combes, Railway Age, 30 Church street, New York City.

MACHINE SHOP PRACTICE DIVISION.—Warner Seely, Warner & Swasey Co., 5701 Carnegie avenue, Cleveland, Ohio.

MATERIALS HANDLING DIVISION.—F. J. Shepard, Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.

OIL AND GAS POWER DIVISION.—W. J. Hargest, American Machinist, 330 West Forty-second street, New York.

FUELS DIVISION.—A. R. Mumford, Consolidated Edison Co., 4 Irving Place, New York.

ASSOCIATION OF AMERICAN RAILROADS.—Charles H. Buford, vice-president operations and maintenance department, Transportation Building, Washington, D. C.

OPERATING SECTION.—J. C. Caviston, 30 Vesey street, New York.

MECHANICAL DIVISION.—V. R. Hawthorne, 59 East Van Buren street, Chicago. Meeting Stevens Hotel, Chicago, June 27 and 28.

PURCHASES AND STORES DIVISION.—W. J. Farrell, 30 Vesey street, New York. Meeting June 25 and 26, Pennsylvania Hotel, New York.

MOTOR TRANSPORT DIVISION.—George M. Campbell, Transportation Building, Washington, D. C.

CANADIAN RAILWAY CLUB.—C. R. Crook, 4468 Oxford avenue, N. D. G., Montreal, Que. Regular meetings, second Monday of each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—J. J. Sheehan, 1101 Missouri Pacific Bldg., St. Louis, Mo. Regular monthly meetings third Tuesday of each month, except June, July and August, DeSoto Hotel, St. Louis, Mo.

CAR DEPARTMENT OFFICERS' ASSOCIATION.—Frank Kartheiser, chief clerk, Mechanical Dept., C. B. & Q., Chicago. Annual meeting October 22-25, Hotel Sherman, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel, Chicago.

CAR FOREMEN'S ASSOCIATION OF OMAHA, COUNCIL BLUFFS AND SOUTH OMAHA INTERCHANGE.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month.

CENTRAL RAILWAY CLUB OF BUFFALO.—Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday of each month, except June, July and August, at Hotel Statler, Buffalo.

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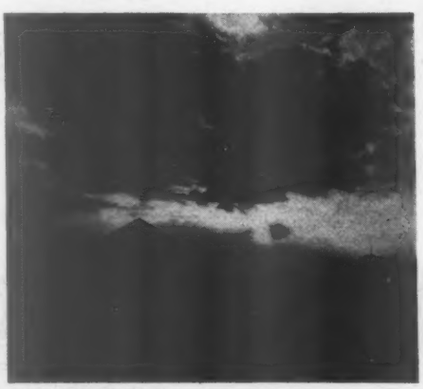

Photo by C. Parker

Sunset over the Boston & Albany yards at Boston, Mass.

EASTERN CAR FOREMEN'S ASSOCIATION.—Roy MacLeod, Room 127, General Office Bldg., N. Y., N. H. & H., New Haven, Conn. Regular meetings, second Friday of January, February, March, April and October at Engineering Societies Bldg., 29 West Thirty-ninth street, New York.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—See Railway Fuel and Traveling Engineers' Association.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—See Locomotive Maintenance Officers' Association.

LOCOMOTIVE MAINTENANCE OFFICERS' ASSOCIATION.—J. E. Goodwin, general foreman, locomotive department Missouri Pacific, North Little Rock, Ark. Meeting Hotel Sherman, Chicago, October 22-25.

MASTER BOILER MAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y. Annual meeting October 22-25, Hotel Sherman, Chicago.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Thursday in each month, except June, July, August, September and December at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings, first Monday each month, except June, July and August, at Midway Club rooms, 1931 University avenue, St. Paul.

NORTHWEST LOCOMOTIVE ASSOCIATION.—G. F. Greenleaf, chief clerk to mechanical engineer, Northern Pacific, St. Paul, Minn. Meeting last Monday of each month, except June, July and August.

PACIFIC RAILWAY CLUB.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Monthly meetings alternately in northern and southern California.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

RAILWAY FUEL AND TRAVELING ENGINEERS' ASSOCIATION.—T. Duff Smith, 1255 Old Colony building, Chicago. Annual meeting, October 22-25, Hotel Sherman, Chicago.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

TORONTO RAILWAY CLUB.—D. M. George, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July and August, at Royal York Hotel, Toronto, Ont.

TRAVELING ENGINEERS' ASSOCIATION.—See Railway Fuel and Traveling Engineers' Association.

VALLEY ANTHRACITE CAR FOREMEN'S ASSOCIATION.—P. P. Kohl, executive secretary, 254 Barney street, Wilkes-Barre, Pa. Regular meetings third Monday of each month.

WESTERN RAILWAY CLUB.—W. L. Fox, executive secretary, Room 822, 310 South Michigan avenue, Chicago. Regular meetings, third Monday in each month, except June, July, August and September.

NEWS

House Passes Bill to Change Titles of Locomotive Inspectors

FOLLOWING through on the Senate's favorable action of April 10, the House of Representatives on April 15 passed and sent to the President the bill (S. 3440) which changes the titles of the chief inspector and assistant chief inspectors of locomotive boilers, respectively, to director of locomotive inspection and assistant directors of locomotive inspection. H. R. 8510, an identical bill which had been reported favorably from the House committee on interstate and foreign commerce, was laid on the table.

The Interstate Commerce Commission has favored the change because of the existing confusion and misunderstanding caused by the fact that the heads of all I. C. C. bureaus, save the Bureau of Locomotive Inspection, have the title of director.

Equipment Depreciation Orders

EQUIPMENT depreciation rates for the Louisiana & Arkansas, the Campbell's Creek and the Helena Southwestern have been prescribed by the Interstate Commerce Commission in a new series of sub-orders and modifications of previous sub-orders in No. 15100, Depreciation Charges of Steam Railroad Companies.

Prescribed rates for the L. & A. are as follows: Steam locomotives—new, 3.19 per cent, secondhand, 6.93 per cent; freight-train cars—new, 3.1 per cent, secondhand, 5.15 per cent; passenger-train cars—new, 2.84 per cent, secondhand, 8.74 per cent; floating equipment—secondhand, 7.78 per cent; work equipment—new, 3.58 per cent, secondhand, 5.43 per cent; miscellaneous equipment—secondhand, 16.22 per cent. Composite percentages (which are not prescribed rates) for all equipment of the Campbell's Creek and the Helena Southwestern, respectively, are 6.22 per cent and 2.7 per cent.

Retirement Board Shifts Personnel

CHANGES in personnel both in Washington, D. C., and in the field were announced by the Railroad Retirement Board on April 17. Edward J. McCormack, who has been chief liaison officer of the Board, has been appointed assistant director of employment and claims, heading the division of clearance and co-ordination, and William A. Rooksbery, who was regional director in Chicago, has been assigned to the position of chief liaison officer of the bureau of employment and claims.

Carlton Hayward, former regional director in Cleveland, Ohio, is now regional director in Chicago, and Patrick F. Murphy, director of field service in the Chicago region, has been named regional director in Cleveland. Earl O. Byrd, manager of the Detroit, Mich., district office, has been appointed director of the Richmond, Va., region. Gerald E. Woodcock, district manager of Peoria, Ill., has been named as head of the Chicago district office.

Davidson Now Assistant Chief Inspector of Locomotives

EDWARD H. DAVIDSON has been appointed by President Roosevelt to be assistant chief inspector of locomotive boilers in the Interstate Commerce Commission's Bureau of Locomotive Inspection. Mr. Davidson, whose nomination went to the Senate for confirmation on April 11, has been a district inspector since 1914. He succeeds John B. Brown, who, at his own request, due to ill health, has been transferred to the Pacific coast as district inspector.

I. C. C. Would Modify Locomotive Inspection Rule 116(b)

RAILROADS have been called upon in an order of the Interstate Commerce Commission, by Commissioner Patterson, to show cause on or before July 1 why Rule 116(b) of the Rules and Instructions for the Inspection and Testing of Steam Locomotives and Tenders and their Appurtenances should not be amended to read as follows:

> The front cab doors or windows of road locomotives used in regions where snowstorms are generally encountered shall be provided with what is known as a "clear vision" window, or an appliance that will clean the outside of such doors or windows over sufficient area to provide a clear view of track and signals ahead. If a "clear vision" window is used it shall be not less than 5 inches high located as nearly as possible in line of the engineman's vision and so constructed and fitted that it may be easily opened, closed and fastened in desired position.

The order states that the change appears desirable "for purposes of uniformity and the promotion of safety of employees and travelers . . ." Language in the foregoing, not found in the present rule, includes the reference to "an appliance that will clean the outside of such doors or windows. . . ."

Equipment Purchasing and Modernization Programs

Illinois Central.—The Illinois Central has asked the Interstate Commerce Commission for authority to assume liability for $4,734,000 of 2½ per cent equipment trust certificates, maturing in 18 equal semi-annual installments of $263,000 beginning September 1, 1940, and ending March 1, 1949. The certificates will be used to finance the acquisition of 2,000 box cars which the company purchased in 1938 and 1939 on a lease arrangement. The $4,734,000 issue will represent 87.3 per cent of the total purchase price of the cars which was $5,420,000.

St. Louis Southwestern.—The St. Louis Southwestern has been authorized by the federal district court to purchase two rebuilt cafe-lounge cars from the Texas & New Orleans for $19,000 each, and to purchase a Pullman car from the Pullman Company for $18,500 and convert it into a cafe-lounge car.

Terminal Railroad Association of St. Louis.—Directors of the Terminal-Railroad Association of St. Louis have approved the purchase of 10 Diesel-electric switching locomotives at a cost of $700,000.

Wabash.—The Wabash has been authorized by the district court to spend $65,300 to improve and repair 100 box cars.

Orders and Inquiries for New Equipment Placed Since the Closing of the April Issue

FREIGHT-CAR ORDERS

Road	No. cars	Type of Car	Builder
Canadian National	150	Convertible ballast	Canadian Car & Fdry. Co.
C. M. St. P. & P.	35*	70-ton hoppers	Gen. Amer. Trans. Corp.
C. R. I. & P.	150*	Gondolas	Pullman-Std. Car Mfg. Co.
D. & R. G. W.	60	70-ton hoppers	Gen. Amer. Trans. Corp.
	10	Caboose	Company shops
Norfolk Southern	100	Stock	Greenville Steel Car Co.
	40	Flat	Magor Car Corp.
	12	Caboose	

FREIGHT-CAR INQUIRIES

A. T. & S. F.	50	70-ton covered hoppers	.....
C. N. O. & T. P.	75	70-ton covered hoppers	.....
D. & R. G. W.	500	50-ton box	.....

PASSENGER CAR ORDERS

Road	No. cars	Type of Car	Builder
Canadian National	5	Mail-express	Canadian Car & Fdry. Co.
	25	Baggage	

*Lease purchase agreement authorized by federal district court.

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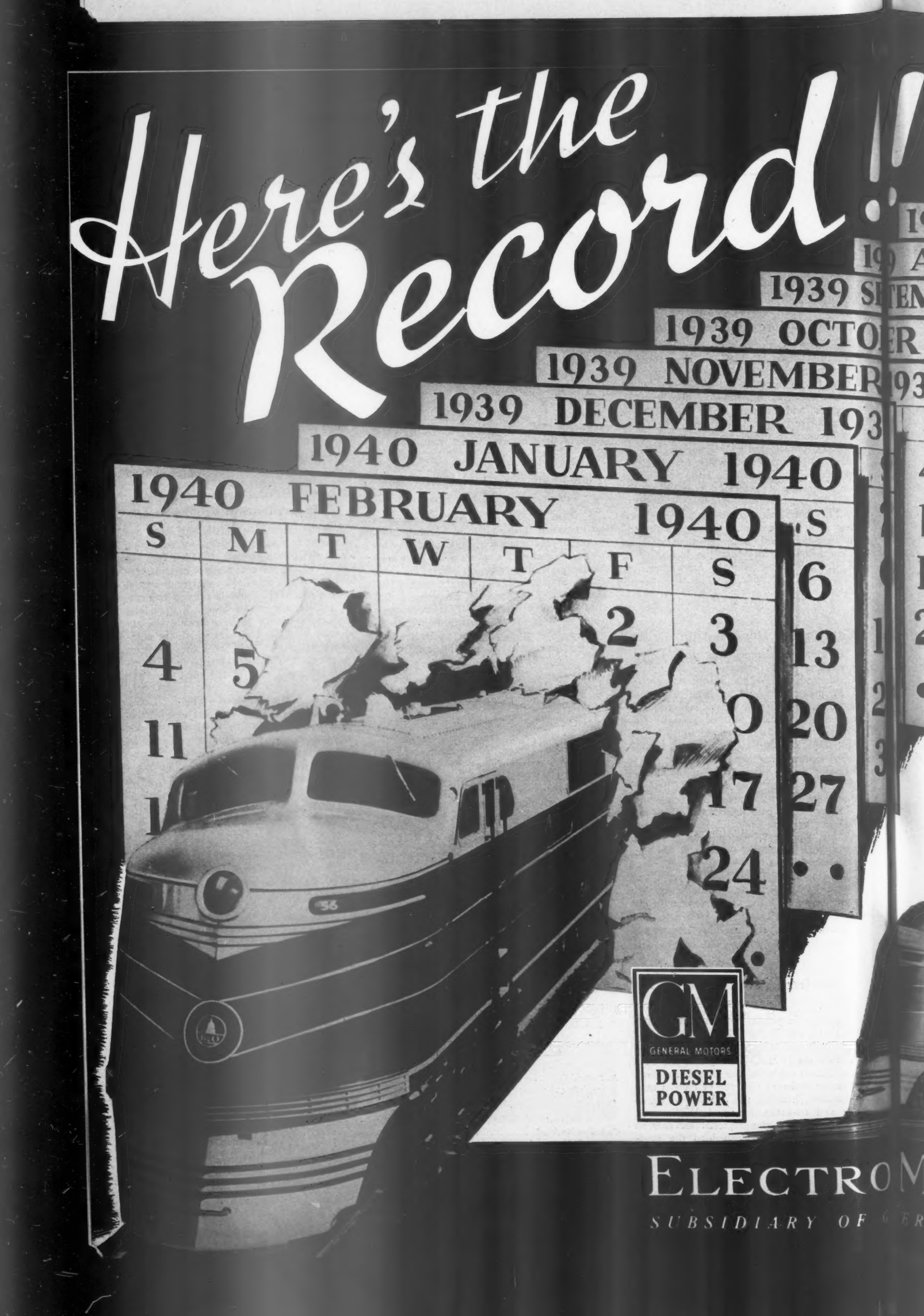
1939 FEBRUARY 1939


Here's the Record!
1939 SEPTEMBER
1939 OCTOBER
1939 NOVEMBER
1939 DECEMBER 193
1940 JANUARY 1940
1940 FEBRUARY 1940
S M T W T F S
6
13
20
27
GM
GENERAL MOTORS
DIESEL POWER
ELECTRO
SUBSIDIARY OF

Every Day for 365 Days Continuous Operation

ON February 27th, Diesel locomotive No. 56, which powers the "Capitol Limited" between Washington, D. C. and Chicago, completed its 365th consecutive run of 771 miles without missing a trip, a total of 281,415 miles... Since being delivered to the Baltimore and Ohio Railroad on June 28, 1938, Diesel locomotive No. 56 had operated 436,718 miles with only three days out of service for repairs — an availability record of 99.6 per cent.

The 100 per cent record of continuous locomotive miles for the past year is a lasting tribute to the Baltimore and Ohio Railroad and is proof of what can be accomplished with this type of motive power.

ROMOTIVE CORPORATION

OF GENERAL MOTORS LA GRANGE, ILLINOIS, U. S. A.

Supply Trade Notes

JOHN S. MACE, district manager of the United States Metallic Packing Company, Philadelphia, Pa., who entered the employ of this company in 1906, retired on May 1. Mr. Mace continues in an advisory capacity, however.

◆

THE PITTSBURGH PLATE GLASS COMPANY, Pittsburgh, Pa., will construct on a 21-acre tract of land at Houston, Tex., a paint plant consisting of three main buildings, auxiliary units and storage tanks.

◆

GEORGE W. ALCOCK, assistant to the president of the Franklin Railway Supply Company, Inc., since 1936 has become a vice-president. His headquarters will continue to be at New York. Mr. Alcock was in the engineering department of the American Locomotive Company from 1902 until the World War, during which he was special assistant to W. H. Marshall in the Production division of the U. S. Army Ordnance Department. At the close of the war, he entered the sales department of Lima Locomotive Works, Inc., and in 1934 was appointed assistant to the president of that company. In 1939 Mr. Alcock became assistant to the chairman, which position he still holds. Since 1934, he has also been secretary and treasurer of The Locomotive Institute.

George W. Alcock

◆

PULLMAN-STANDARD CAR MANUFACTURING COMPANY.—*Norman B. Johnson,* manager of freight shops of the Pullman-Standard Car Manufacturing Company, Chicago, has also been appointed acting chief engineer to succeed *A. Christianson,* who has asked to be relieved of his duties, but remains in the service of the company as consulting engineer. *M. R. Kempton,* principal engineer, has been promoted to engineer of freight for all plants, with headquarters at Michigan City, Ind.

AIR REDUCTION CO.—*John J. Crowe,* manager of the Apparatus Research and Development department of the Air Reduction Company, New York, has been appointed assistant to *Herman Van Fleet,* vice-president and operating manager. Mr. Crowe will direct the activities of the Apparatus Research and Development department and will co-ordinate these activities with similar activities for Wilson Welder & Metals Co., Inc. In addition, he will handle apparatus, patent matters for Mr. Van Fleet. *H. E. Landis, Jr.,* assistant to Mr. Crowe, has been appointed manager of the Apparatus Research and Development department and *C. G. Andrew* has been appointed manager of gas plants.

◆

DUFF-NORTON-MFG. CO.—*Earl E. Thulin,* district manager of Duff-Norton Manufacturing Company at Chicago, has been elected vice-president and general manager of sales. For the present, he will be located at Chicago and later in the year will move to the general offices at Pittsburgh, Pa. *C. N. Thulin,* vice-president at Chicago, will act in a sales executive capacity as a special representative in all territories. *W. I. Floyd,* assistant to the president, at Pittsburgh, has also been appointed assistant general manager of sales, with the same headquarters.

Earl E. Thulin

Earl E. Thulin was born on May 8, 1901, in St. Paul, Minn., and after graduating from Lane Technical High School in Chicago, entered the employ of the sales and service department of the Duff-Norton Manufacturing Company. Later he was promoted to district manager at Chicago.

◆

INTERNATIONAL NICKEL CO., INC.—*F. L. LaQue,* assistant director of technical service on mill products for The International Nickel Company, Inc., in New York, is now engaged in development activities on all applications of both ferrous and nonferrous nickel-containing alloys. Mr. LaQue has been associated with International Nickel since 1927, devoting his activities to the field of corrosion and corrosion-resisting materials. *Dr. William A. Mudge,* works metallurgist of the rolling mill at Huntington, W. Va., who has been with the company since 1920, and who recently joined the technical service section of the Development and Research division in New York, has been appointed assistant director of technical service to succeed Mr. LaQue.

Obituary

ARTHUR G. HOLLINGSHEAD, president of the Viloco Railway Equipment Company, the Okadee Company and the Viloco Machine Company, Chicago, died in University Hospital in that city on April 23.

◆

FRANK A. PURDY, manager of sales of the Vapor Car Heating Company of Canada, Ltd., Montreal, Que., died in that city on March 21, at the age of 74 years. He had been with the company since January, 1916.

◆

L. GERARD SMITH, assistant treasurer of the Vapor Car Heating Company of Canada, Ltd., Montreal, Que., died in that city on March 14, at the age of 68 years. He had been in the employ of the company since May, 1922.

◆

CHARLES J. NASH, retired president of the Universal Draft Gear Attachment Company, died in Chicago on April 9.

Charles J. Nash

Mr. Nash was born in Blue Earth, Minn., in 1865 and was educated at the University of Minnesota. He began his railroad career with the Great Northern, and was later employed by the Diamond Iron Works, the La Fayette Car Works, the Pullman Company, the Standard Steel Car Company, and the Westinghouse Air Brake Company. In 1912 Mr. Nash helped found the Universal Draft Gear Attachment Company, and from that date until his retirement in 1932 was its president.

Personal Mention

General

I. I. SYLVESTER, special engineer of the Canadian National, has been appointed chief inspector of Diesel equipment, with headquarters as before at Montreal, Que.

A. W. THORSON has been appointed assistant fuel service engineer of the Chesapeake & Ohio, with headquarters in the General Motors Building, Detroit, Mich.

HARVEY H. JONES, general locomotive foreman of the Cheyenne shops of the Union Pacific at Cheyenne, Wyo., has been promoted to assistant to the superintendent of motive power and machinery, Western districts, with headquarters at Pocatello, Idaho.

E. R. BUCK, master mechanic on the Pennsylvania at Pitcairn, Pa., has been appointed superintendent of motive power of the Wabash, with headquarters at Decatur, Ill., succeeding George Franklin Hess, who retired on April 18.

GEORGE FRANKLIN HESS, superintendent of motive power of the Wabash at Decatur, Ill., retired on April 18. Mr. Hess was born at Ft. Wayne, Ind., on January

George Franklin Hess

1, 1872, and entered railway service as a messenger boy in the mechanical department of the Pennsylvania in 1886. In March, 1887, he became a machinist apprentice in the Pennsylvania shops at Ft. Wayne, and four years later was appointed a machinist. He later served on the Cleveland & Pittsburgh (now part of the Pennsylvania) at Wellsville, Ohio, the Cleveland, Canton & Southern (now part of the Wheeling & Lake Erie) at Canton, Ohio, the Atchison, Topeka & Santa Fe, at Raton, N. M., the Cleveland, Cincinnati, Chicago & St. Louis (Big Four), at Wabash, Ind., and the Wabash at Ft. Wayne, Ind. In September, 1897, he was promoted to enginehouse foreman at Montpelier, Ohio, and a short time later was transferred to Delray, Mich. In May, 1899, he joined the Grand Trunk Western as general foreman at Detroit, Mich., and later served the Chicago, Rock Island & Pacific as enginehouse foreman at Pratt, Kan., and at Caldwell, Kan. In July, 1902, Mr. Hess was advanced to general foreman of the 47th Street (Chicago) shops, and March, 1903, he went with the Baltimore & Ohio as erecting foreman at Newark, Ohio. One month later, was appointed general foreman at South Chicago, and in June, 1903, was promoted to the position of master mechanic at Lorain, Ohio. In November, 1910, he was transferred to Chillicothe, Ohio, and on August 1, 1911, was appointed superintendent of machinery of the Kansas City Southern, with headquarters at Pittsburg, Kan. Mr. Hess was appointed superintendent of motive power of the Wabash, with headquarters at Decatur, Ill., on June 1, 1920, holding that position until his retirement.

Master Mechanics and Road Foreman

C. E. FARLEY, who has been appointed master mechanic of the Chicago, Rock Island & Pacific at Des Moines, Iowa, as noted in the April issue, was born on September 18, 1881, at Brockfield, Mo. He attended public school at Trenton, Mo., and in 1899 became a machinist apprentice on the Rock Island. During 1903, 1904 and 1905 he served on various railroads—the Illinois Central, the Missouri Pacific, the Wabash, the Cleveland, Cincinnati, Chicago & St. Louis, and the Chicago & Eastern Illinois—as a machinist. He returned to the Rock Island at Horton, Kan., in 1905, being promoted to the position of erecting foreman on September 1, 1910. He became general foreman at Goodland, Kan., in March, 1915; general foreman at Cedar Rapids, Iowa, in June, 1917, and general foreman at Horton, in April, 1919. He was appointed master mechanic at Silvis, Ill., on March 1, 1937, and was transferred to Des Moines in February, 1940.

C. S. HOGAN, who has been appointed master mechanic of the McCloud River Railroad at McCloud, Calif., as noted in the April issue, was born on June 20, 1895, at San Francisco, Calif. His grade school education was followed by extension courses. On September 1, 1910, he became a messenger boy in the freight department of the Southern Pacific. In May, 1911, he entered the mechanical department as a messenger, subsequently becoming a machinist apprentice. In December, 1917, he enlisted as a machinist mate in the United States Navy. He returned to the Southern Pacific in March, 1919, and until February, 1926, was machinist lead valve man and extra foreman. In the latter year he became assistant master mechanic of the McCloud River Railroad, and in February, 1940, was appointed master mechanic.

Car Department

T. J. PAYNE, car foreman on the Canadian Pacific at Outremont, Que., has retired.

JOSEPH V. PASEWICK has been appointed assistant general car foreman of the New York, Chicago & St. Louis, with headquarters at Chicago.

Shop and Enginehouse

J. A. SPEIR, night enginehouse foreman of the Chesapeake & Ohio at Huntington, W. Va., has been promoted to the position of day enginehouse foreman at Huntington.

R. A. PYNE, Jr., shop foreman of the Canadian Pacific at Kenora, Ont., has become locomotive foreman with the same headquarters.

H. J. CANTRELL, foreman on the Chesapeake & Ohio at Huntington, W. Va., has been promoted to the position of night enginehouse foreman at Huntington.

E. J. SANDERS, enginehouse foreman of the Chesapeake & Ohio at Huntington, W. Va., has been appointed general foreman, with headquarters at Fulton, Va.

JOSEPH D. FARLEY, assistant to supervisor of lubrication and supplies of the Chesapeake & Ohio at Richmond, Va., has been appointed assistant enginehouse foreman, Fulton shops.

Purchasing and Stores

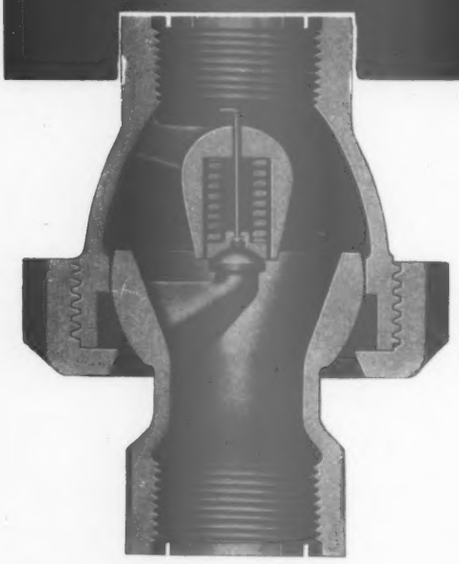
J. L. SULLIVAN, storekeeper on the Union Pacific at the Omaha (Neb.) general store, has been promoted to assistant general storekeeper at Omaha.

H. M. SMITH, general storekeeper on the Northern Pacific at Saint Paul, Minn., retired on April 1 after 41 years of service. Mr. Smith was born at Dover, Minn., on July 11, 1873, and entered railway service on December 13, 1899, as a stores attendant in the St. Paul shops of the Northern Pacific. He advanced through various positions in the stores department until 1921, when he was appointed traveling storekeeper. Five years later, Mr. Smith was promoted to the position of assistant general storekeeper at St. Paul, and on August 1, 1932, became general storekeeper.

Obituary

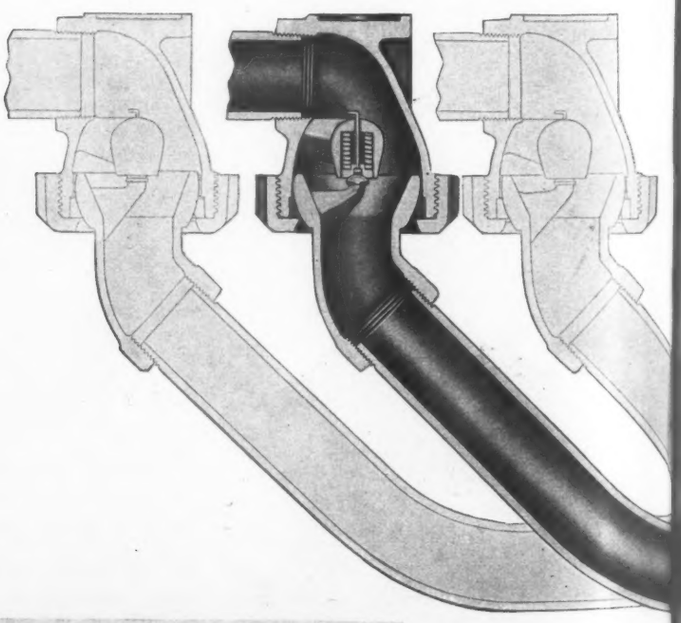
M. F. BROWN, fuel supervisor of the Northern Pacific, with headquarters at St. Paul, Minn., died suddenly of a heart attack on April 13.

Announcing THE NEW



THE BARCO Type X streamlined flexible ball joint incorporates important and entirely new features of design resulting in longer life with freedom from leakage of fluids or air. It has automatic adjustment to compensate for wear, expansion and contraction encountered with varying or fluctuating pressures and temperatures.

33-1/3% more flexibility—Automatic adjustment—Uniform contact between the ball and gasket in all positions—Number of gaskets reduced 50%—Heavy square threads between nut and casing—High volume efficiency.



These latest 4-8-4 freight locomotives are equipped with BARCO type 3VX connections and BARCO type M-13RB reverse gears.

BARCO MANUFACTURING